



## **Enhanced Night Vision Goggle Customer Test**

**by Christian B. Carstens, Charles C. Bonnett, and Elizabeth S. Redden**

**ARL-TR-3839**

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# **Army Research Laboratory**

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**Human Research & Engineering Directorate, ARL**

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14. ABSTRACT This study was conducted to evaluate a prototype enhanced night vision goggle (ENVG) that combines thermal and image intensification (I <sup>2</sup> ) capabilities. Two infantry squads acted as participants. Soldiers were trained to use the ENVG and they received familiarization training on a baseline I <sup>2</sup> device (AN/PVS-14). The exercises included woodland individual movement techniques (IMT) course trials; military operations in urban terrain (MOUT) target detection trials; land navigation exercises; MOUT defensive and offensive exercises; night rifle qualification course exercises; ambush and patrol exercises; and human factors compatibility exercises. The experiment was conducted in May and June 2004, during hours of darkness, at various sites in Fort Benning, Georgia. Results indicated that the fused night vision device (NVD) enhanced the capability to detect heat-emitting targets, especially through obscurants, without interfering with movement through woodland, open fields, and urban terrain. Fusion diminished the negative impact on target detection and engagement when smoke was introduced. In the woodland environment, fusion did not interfere with IMT times and did increase the range at which thermal and human targets were detected. Deep shadows, camouflage, and smoke did not mask targets when the thermal overlay was used. In the MOUT setting, fusion technology provided significantly better target detection capability than was provided by the I <sup>2</sup> baseline. When used in the fusion mode, the ENVG device was compatible with the AN/PAQ-4C and AN/PEQ-2 laser aiming devices. Fusion capability did not, however, enhance firing accuracy for heat-emitting targets on the night qualification range. Limitations in the configuration, mount design, system controls, and visual characteristics of the fused NVD were identified and discussed.					
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# 1. Introduction

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## 1.1 Statement of the Problem

Paragraph 2.0 of the 1998 Editorial Draft of the U.S. Army Infantry Center's (USAIC) "Own the Night Master Plan for Dismounted Systems" states that during the 1980s, the Army night vision inventory for dismounted infantry was essentially limited to image intensifiers. The technology barriers that prevented low power, lightweight thermal imaging devices from being manufactured within affordable prices drove this limitation. Technological advancements have now addressed this limitation. One of the newest devices undergoing consideration by the U.S. Army is the enhanced night vision goggle (ENVG). The ENVG is envisioned to be a lightweight, passive, sensor-fused, electro-optical night vision device (NVD), which will increase the Soldier's ability to engage and execute close combat, combat support, and combat service support operations in all levels of illumination, adverse weather, and battlefield-obscurant conditions. Major General Paul D. Eaton, former Commandant of the U.S. Army Infantry School, sent a letter of support to the Program Executive Officer Integrated Electronic Warfare Systems (PEO-IEWS) in the ongoing ENVG developmental efforts being conducted by Project Manager Night Vision/Reconnaissance, Surveillance and Target Acquisition (PM NV/RSTA) in January 2002. In a briefing about ENVG to the Director of Combat Developments (DCD) U.S. Army Infantry School on 9 February 2002, representatives from the PEO listed several issues with the current systems:

- Image intensifiers have degraded performance in adverse battlefield and environmental conditions, including smoke, fog, dust, bright light, and very low light levels.
- Low light level range performance and resolution result in a significant decrease in performance as light level decreases.
- Current systems limit Soldiers' abilities to perform individual movement techniques (IMT) because of their significant forward projection, large moment arm, and mounting configuration.

The representatives suggested four avenues to improve performance and address these shortcomings:

- Miniature NVD,
- Miniature NVD with sensor fusion,
- Video-based NVD, and
- Video-based ENVG with sensor fusion.

Their recommendation to the DCD was a miniature NVD with sensor fusion.

In 2003, a field test of three prototype ENVGs was conducted at Fort Benning, Georgia (Bonnett, Redden, & Carstens, 2005). The experimental exercises included open field target detection trials with and without smoke; woodland patrolling and target detection trials with and without smoke; woodland IMT course trials; military operations in urban terrain (MOUT) IMT course trials; MOUT target detection trials with and without smoke; and tunnel-clearing course trials. A human factors engineering (HFE) evaluation of the ENVG was also performed. Results indicated that effectively fused NVDs enhanced target detection capability, especially through obscurants, without interfering with movement through rough terrain. Specifically, results indicated that effective fusion significantly increased the Soldiers' ability to detect targets in an open field during smoke and no-smoke conditions. Effective fusion diminished the negative impact on target detection when smoke was introduced. In the woodland environment, effective fusion did not interfere with cross-country movement times and increased the range at which thermal and human targets were detected. Deep shadows, camouflage, and smoke did not mask targets when the thermal overlay was present. In the MOUT setting, effective fusion provided significantly greater target detections during smoke conditions than was provided by the image intensification ( $I^2$ ) baseline. When used in the fusion mode, the ENVG devices were compatible with the AN/PAQ-4C<sup>1</sup> and AN/PEQ-2<sup>2</sup> laser aiming devices. Thus, Soldiers could accurately fire their weapons and receive the benefit of thermal target detection capabilities without a thermal weapon sight.

One of the ENVGs used in the 2003 experiment was evaluated in the present study.

## **1.2 Objectives**

The objective of this experiment was to document the contribution of night vision fusion capabilities in the ENVG system relative to an existing NVD system and its effect on infantry performance. Seven individual field exercises were conducted to evaluate the performance of the candidate ENVGs. The objectives for the exercises and their major goals are described next.

### **1.2.1 Woodland IMT Trials**

- Assess the impact of ENVG design on negotiating each obstacle or event in the woodland IMT course.
- Assess the ability of Soldiers to acquire targets using the baseline and prototype NVDs.
- Record the Soldiers' overall ratings of the woodland IMT course negotiation with baseline and prototype NVDs.

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<sup>1</sup>Army/Navy human-portable invisible light special 4C

<sup>2</sup>Army/Navy human-portable laser special 2

### **1.2.2 MOUT Target Detection Trials**

- Assess the impact of ENVG design on speed and accuracy of target detection in a MOUT environment.
- Record the Soldiers' overall ratings of the baseline and prototype NVDs for target detection within a MOUT environment.

### **1.2.3 Land Navigation Course**

- Assess the impact of ENVG design on the speed and accuracy of land navigation.
- Document the number and type of errors made during the land navigation trial.
- Record the Soldiers' overall ratings of the baseline and prototype NVDs for land navigation.

### **1.2.4 MOUT Attack and Defend Mission**

- Assess the impact of ENVG design for the execution of MOUT attack and defend exercises.
- Document the efficiency of target detection, recognition, and engagement in a MOUT setting with baseline and prototype NVDs.
- Document the number and type of errors made during the MOUT defense mission.
- Record the Soldiers' overall ratings of ease of completing the MOUT defense mission with baseline and prototype NVDs.

### **1.2.5 Night Qualification Live Fire**

- Assess the impact of ENVG design for night qualification course performance.
- Record the Soldiers' overall ratings of ease of completing the night qualification course with baseline and prototype NVDs.

### **1.2.6 Hasty Ambush and Patrol**

- Assess the impact of ENVG design for executing a hasty ambush and a night tactical patrol.
- Document the number and kinds of errors made during the hasty ambush with baseline and prototype NVDs.
- Record the Soldiers' overall ratings of ease of completing the hasty ambush with baseline and prototype NVDs.

### **1.2.7 Human Factors Engineering Trials**

- Assess the impact of ENVG design on donning and doffing the NVDs.
  - Assess the impact of ENVG design on compatibility with clothing, equipment, and standard firing positions.
  - Record the Soldiers' overall ratings of ease of donning and doffing the NVDs, as well as their ratings of NVD compatibility with clothing and equipment.
- 

## **2. Method**

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### **2.1 Overview**

This experiment was executed during six weeks with a total of eight infantry squads. At any given time, two squads participated over a seven-day block. Soldiers first received familiarization training on the baseline and the prototype night vision devices. They were then briefed at the start of each exercise to explain the nature of the exercise and what was required of them during the event. An array of field-based exercises was chosen to assess various aspects of ENVG systems. These included woodland IMT course trials; MOUT target detection trials; land navigation trials; MOUT attack and defend missions; night qualification live fires; and hasty ambush and patrol missions. An HFE evaluation of the ENVGs was also conducted. The experiment was conducted during the hours of darkness at Fort Benning, Georgia, during May and June 2004.

### **2.2 Participants**

A total of 72 Soldiers (eight nine-man squads) was used as subjects during this experiment. Five squads came from the Mountain Division, and three squads came from the Ranger Training Brigade (RTB). The requested Soldiers had a military occupational specialty that requires the use of NVDs, performance of mobility and portability maneuvers (movement-to-contact and assault maneuvers), and movement as a dismounted element that is associated with their profession. No specialized experience was required. However, the Soldiers were shown how to negotiate the courses safely and were trained in specific procedures as required.

Although the unit was officially requested for troops, it was made clear that Soldier participation in the experimentation would be voluntary. The following ensured the voluntary nature of participation: copies of the consent form were provided to all participating subjects. They were given an opportunity to review the experiment objectives, have any of their questions answered by the investigators, and were asked to sign a form indicating their informed voluntary consent to participate. If any designated subject chose not to participate in any of experiment trials planned, the unit would have been asked to recruit another volunteer. All tasks planned for this

experiment were a normal part of the infantry job. The Project Manager, Sensors and Lasers, obtained a safety release for all experimental equipment.

The Soldiers completed this experiment using the baseline and prototype NVDs while wearing their “fighting load” as follows: underclothing and socks; battle dress uniform (BDU); belt and buckle, boots; personal armor system for ground troops (PASGT) helmet, tactical load-bearing vest with pistol belt; two canteens with covers; two grenade pouches; first-aid bandage in pouch; knee pads; elbow pads, and interceptor body armor. They carried their assigned M16A4 or M4 rifle, upon which was mounted an AN/PEQ-2A aiming light.

### **2.2.1 Pre-Test Orientation and Volunteer Agreement**

The Soldiers were given an orientation about the purpose of the study and their participation. They were briefed about the objectives and procedures for each experiment, as well as the NVDs they were required to use throughout the investigation. They were also told how the results would be used and the benefits that the military can expect from this investigation. Any questions the subjects had regarding the study were answered. In addition, a volunteer agreement affidavit was explained and its contents were verbally presented. The Soldiers were then given the volunteer agreement affidavit to read and sign if they decided to volunteer.

### **2.2.2 Medical Review and Screening**

Upon arriving at the experiment site, the investigators asked the Soldiers if any of them had a medical profile or history that would jeopardize them if they participated in the study. Each Soldier was asked if he had any history or allergic reaction or any other adverse reaction to smoke. Soldiers were also asked to complete a medical status form.

### **2.2.3 Demographics**

Demographic data were taken for each Soldier. Data concerning their infantry experience and their experience with NVDs were included in the demographic questionnaire.

## **2.3 Apparatus**

### **2.3.1 Standard and Candidate Item Descriptions**

#### **2.3.1.1 AN/PVS-14<sup>3</sup>**

The AN/PVS-14 is a hand-held, helmet-mounted, head-mounted, or weapon-mounted monocular night vision device that enables walking, driving, weapon firing, short-range surveillance, map reading, vehicle maintenance, and first aid in moonlight and starlight. The AN/PVS-14 was the baseline device used during the study. Each unit allows for vertical adjustment (using head

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<sup>3</sup>Army/Navy human-portable visual search 14.

straps), fore and aft adjustment, objective lens focus, and eyepiece focus. The device is also equipped with an infrared (IR) light-emitting source with a variable gain control. The monocular device automatically shuts off when disconnected from the head mount or helmet mount. Equipment data are presented in table 1.

Table 1. AN/PVS-14 equipment data.

<b>Weight</b>	<b>356 grams (without accessories)</b>
Battery requirements	2 AA alkaline or 2 AA 1.5V DC lithium
Field of view	40°
Operating temperature	-20 to +95° F
Illumination required	Overcast starlight to moonlight
Optimum light level resolution	1.35 cy/mr
Forward projection	149 mm
Lateral protrusion	46 mm
CG location from trignon	178 mm
Mount to PASGT helmet	Yes
Mount to head harness	Yes
Distortion	<2%
Magnification	1X ± .02
Eye relief	25 mm
Exit pupil	14 mm
Diopter focus range	+2 to -6
Range focus	25 cm to infinity
Integral battery pack	Yes
Fused IR imagery	No

### 2.3.1.2 Candidate ENVG

This candidate ENVG's design philosophy is to provide a small NVD that can be hand held or mounted on a combat helmet. It completely integrates an IR camera and an I<sup>2</sup> system into a single monocular device. The monocular itself does not contain batteries but derives power from a helmet-mounted battery pack (when helmet mounted) or a clip on battery pack (when hand held). The resultant system (monocular, helmet mount, helmet-mounted battery pack) is compact, with a weight of approximately 900 grams. The primary goal of this design is "optical fusion in a small package".

The Soldiers were able to set the ENVG on 100% I<sup>2</sup>, 100% thermal, or a continuous range of blends.

The field of view (FOV) for the I<sup>2</sup> component is a circular 40 degrees. The thermal image covers a diagonal 24-degree rectangular FOV positioned in the center of the I<sup>2</sup> FOV. By area, this thermal area equates to approximately 1/3 of the total I<sup>2</sup> FOV. During the thermal initialization (warm-up) mode, only 1/3 of the I<sup>2</sup> image (by area) is blocked, but it is the center of the area, which may tend to make it seem like it blocks the entire image. Equipment data are shown in table 2.



The minimum system resolution for both the PVS-14 and the ENVG is 1.3 cy/mr. The AN/PVS-14 and the ENVG use different image intensifiers, but they function in very much the same manner. Both have very similar performance specifications, both have variable gain that allows the Soldier to vary the gain to actual operational light conditions, and they both have bright source protection and automatic brightness control. This means that the optimal light level value would essentially be the same for both. The optimal light level is the light level in which the NVD system provides the best resolution. This will normally be somewhere between half and full moon but can vary slightly from system to system.

Table 2. Candidate ENVG equipment data.

System	Specification
Forward Projection	128 mm (from eye)
Total System Weight (including helmet mount, batteries, cables, etc.)	865 grams (4-cell battery pack, lithium batteries)
Battery Type Operating Life (one set of batteries)	Based on using "AA" lithium cells >0°C: 8 hours (4-cell battery pack)
Image Intensifier	
Photocathode Sensitivity	2,000 microamps per lumen
Signal-to-Noise Ratio	25
Luminance Gain	50,000
Halo	0.9 mm
Center Resolution	64 line pairs per millimeter (lp/mm)
High Light Resolution	36 lp/mm
Thermal Camera	
Array Size	320 x 240
Pixel Size	25 microns
Field of View	19.2°(H) x 14.4° (V) (24 degree diagonal)
Resolution (multi-resolution time domain)	Less than a line form by two points on a graph: 0.08°C at 0.05 cycle per milliradian (cy/mr) 0.59°C at 0.30 cy/mr
Noise equivalent delta temperature (NEDT)	<= 100 mK at ambient/hot set points (external ambient -7C to +60 C) <= 150 mK at cold set point (external ambient -37 C to -7 C)
Frame Rate	60 Hz
Camera Start-up Time	10 seconds at 25° C

## 2.3.2 Infantry Task Courses

### 2.3.2.1 Woodland IMT Course

The woodland IMT course design required Soldiers to use virtually all non-MOUT tactical maneuvers and IMTs. The course is situated in a field setting with 10 obstacle areas. It required Soldiers to execute a variety of individual movements and assume a variety of positions while maneuvering through, over, under, and around obstacles. Obstacles included (a) pipe crawl area, (b) zigzag area, (c) 2-ft jump, (d) hill, (e) low crawl area, (f) combat roll station, (g) high crawl area, (h) kneeling firing position station, (i) high wall, and (j) prone firing position station. Appendix A shows a sketch of the course.

### 2.3.2.2 MOUT Target Detection Lane

The MOUT target detection dismounted lane is a 200-meter-long hardtop road between two rows of buildings. There are eight scanning positions and 30 specific target locations in the course. There are one to six specific target locations associated with each scanning position, as indicated in appendix B.

Soldiers negotiated the course according to table 3. Targets were placed along the route and rotated every iteration according to table 4 which shows the target types (human, thermal, and hard) and the specific target locations used at each of the seven scanning positions.

Table 3. MOUT target detection lane positions.

Position	Soldiers' Stance	Position Location	Target Sector	Movement/Negotiation
Start	Prone	Ready Line	West end A2	<ul style="list-style-type: none"> <li>• Rush</li> <li>• Arrive position 1</li> </ul>
1	Kneeling	West end A1	Southwest side A2	<ul style="list-style-type: none"> <li>• Enter NW doorway</li> <li>• Through first "mouse" hole</li> <li>• Through second mouse hole</li> <li>• Arrive position 2</li> </ul>
2	Kneeling	North side A1 window	South side A2	<ul style="list-style-type: none"> <li>• Through window</li> <li>• Rush</li> <li>• Arrive position 3</li> </ul>
3	Prone	Northwest end A3	Southeast side A2	<ul style="list-style-type: none"> <li>• Rush to A4</li> <li>• Through window west end</li> <li>• Arrive position 4</li> </ul>
4	Kneeling	South side A4 window	West end B1	<ul style="list-style-type: none"> <li>• Through window</li> <li>• Rush</li> <li>• Arrive position 5</li> </ul>
5	Prone	Northwest corner B1	South side B2	<ul style="list-style-type: none"> <li>• Rush</li> <li>• Arrive position 6</li> </ul>
6	Kneeling	Southwest corner B2	West side B3	<ul style="list-style-type: none"> <li>• Rush</li> <li>• Enter SE doorway B2</li> <li>• Through window</li> <li>• Rush</li> <li>• Through mouse hole west side</li> <li>• Rush</li> <li>• Arrive position 7</li> </ul>
7	Prone	Southeast B4 "mouse" hole	North side B5	<ul style="list-style-type: none"> <li>• Finished</li> </ul>

Table 4. MOUT target detection target location.

Scan Position	Target Location	Iteration		
		1	2	3
Start Point	1			Human
	2		Human	
1	3			Thermal
	4			
	5			Hard
	6	Human		
	7		Human	
2	8			Human
	9	Human		
	10	Thermal	Hard	
	11			
	12	Human		Thermal
3	13	Hard	Human	Human
	14			
	15		Human	
	16			
4	17	Human	Hard	
	18	Thermal		
	19		Thermal	
	20			Thermal
	21			
	22	Hard		
5	23			
	24		Human	Hard
	25			
	26	Hard	Thermal	
6	27			Human
	28		Hard	Human
7	29			
	30	Thermal		

### 2.3.2.3 Land Navigation Course

The land navigation exercise was designed to assess the ability of individual Soldiers to move over unfamiliar wooded terrain at night using the baseline and prototype NVDs. The land navigation course used is the USAIC Professional Leadership Development Course. The three lanes are 610, 680, and 770 meters long. The course layout is given in appendix C.

### 2.3.2.4 MOUT Attack and Defend Mission

The MOUT attack and defend mission was designed to enable a squad to perform command and control activities, target detection, and target engagement while using NVDs. On each iteration, one squad acted as the defenders while the second squad played the role of attackers. The defensive mission is to defend buildings B2 and B4 at the McKenna MOUT site from an attack coming from an easterly direction. There were 12 designated defensive positions in and around buildings B2 and B4. The course layout is shown in appendix D. The defenders, attackers, and civilians wore sensor systems to determine kills throughout the exercise. The locations of defenders and three civilians were randomized, as shown in table 5.

Table 5. MOUT defensive positions.

Roster	Squad 1			Roster	Squad 2		
	Iteration				Iteration		
	2	4	6		1	3	5
1	3	8	10	10	1	11	2
2	4	5	7	11	9	12	7
3	11	12	8	12	10	3	10
4	2	6	9	13	6	7	4
5	12	10	12	14	2	8	8
6	1	11	6	15	12	6	1
7	8	1	4	16	4	5	11
8	5	9	1	17	11	10	3
9	7	2	3	18	5	2	5
Civ 1	6	7	11	Civ 1	3	4	6
Civ 2	10	3	5	Civ 2	8	1	9
Civ 3	9	4	2	Civ 3	7	9	12
Soldier	Squad 3			Soldier	Squad 4		
	Iteration				Iteration		
	2	4	6		2	4	6
1	2	8	5	1	2	8	5
2	7	7	1	2	7	7	1
3	8	5	11	3	8	5	11
4	1	3	3	4	1	3	3
5	4	10	2	5	4	10	2
6	9	11	10	6	9	11	10
7	12	12	8	7	12	12	8
8	10	6	6	8	10	6	6
9	11	1	4	9	11	1	4
Civ 1	6	4	12	Civ 1	6	4	12
Civ 2	5	2	9	Civ 2	5	2	9
Civ 3	3	9	7	Civ 3	3	9	7
Roster	Squad 5			Roster	Squad 6		
	Iteration				Iteration		
	2	4	6		2	4	6
1	12	4	4	1	12	4	4
2	6	9	7	2	6	9	7
3	11	5	11	3	11	5	11
4	10	6	1	4	10	6	1
5	7	11	6	5	7	11	6
6	8	2	2	6	8	2	2
7	2	1	5	7	2	1	5
8	3	8	9	8	3	8	9
9	4	7	12	9	4	7	12
Civ 1	1	10	10	Civ 1	1	10	10
Civ 2	5	3	8	Civ 2	5	3	8
Civ 3	9	12	3	Civ 3	9	12	3
Soldier	Squad 7			Soldier	Squad 8		
	Iteration				Iteration		
	2	4	6		2	4	6
1	6	2	6	1	6	2	6
2	3	9	8	2	3	9	8
3	10	1	7	3	10	1	7
4	11	8	11	4	11	8	11
5	2	11	10	5	2	11	10
6	9	6	1	6	9	6	1
7	12	12	2	7	12	12	2
8	1	4	5	8	1	4	5
9	5	10	3	9	5	10	3
Civ 1	8	3	12	Civ 1	8	3	12
Civ 2	7	7	4	Civ 2	7	7	4
Civ 3	4	5	9	Civ 3	4	5	9

### 2.3.2.5 Night Qualification Course

The night qualification course was used to assess target acquisition and engagement with the M16A4/M4 carbine using NVDs. The range layout is presented in appendix E. A modified night rifle marksmanship program of instruction (POI) was used to provide practice and record fire qualification (table 6).

Table 6. Night qualification scenario.

<b>M4/M16 Night Qualification Range Scenario</b>				
	<b>Foxhole</b>		<b>Prone</b>	
<b>Exposure</b>	<b>Range</b>	<b>Time</b>	<b>Range</b>	<b>Time</b>
1	50 L	3 sec	100	5 sec
2	200	6 sec	200	8 sec
3	100	4 sec	150	6 sec
4	150	5 sec	50 L/200	12 sec
5	100	4 sec	150/100	12 sec
6	150	5 sec	50 R/100	12 sec
7	50 R	3 sec	100	8 sec
8	200	6 sec	150	8 sec
9	150	5 sec	50 R	5 sec
10	250	7 sec	100/200	12 sec
11	100/200	8 sec	150/50 L	12 sec
12	150/50 R	9 sec	100/150	12 sec
13	100/150	8 sec	200/100	12 sec
14	200	6 sec		
15	150	5 sec		
16	50 L/250	9 sec		

### 2.3.2.6 Hasty Ambush and Patrol

The hasty ambush lanes are located in the A15 training area. Fire teams executed a linear hasty ambush. Each fire team moved from a secured location into their ambush location without being detected. The fire teams conducted a tactical patrol along a given route. The ambush team executed the ambush when the patrol reached the kill zone. The ambush layout is given in appendix F.

## 2.3.3 Common Clothing and Equipment Items

Table 7 provides a list of the common clothing and equipment items that were worn and carried during the experiment.

Table 7. Common clothing and equipment items.

<b>Item Description</b>
Underclothing and socks
Battle dress uniform
Belt with buckle
Boots
Personal armor system for ground troops (PASGT) helmet
Tactical load-bearing vest with pistol belt
Canteen with cover, and 1 quart of water (two each)
Individual first aid kit
M4/M16A4 carbine with PEQ-2A
Ammunition pouches (two)
Elbow and knee pads (two each)
Interceptor body armor

### **2.3.4 Questionnaires**

Questionnaires were designed to elicit Soldiers' opinions about their performance and experiences with the two NVDs. The questionnaires were designed to enable Soldiers to rate the devices on a 7-point semantic differential rating scale ranging from "extremely good" to "extremely bad." Questionnaires were administered to each Soldier at the completion of the training course for each NVD and at the completion of each of the trials with each of the devices. At the end of each group's participation in the experiment, it completed a questionnaire ranking the NVDs on a number of dimensions.

## **2.4 Procedures**

### **2.4.1 Demographics and Training**

Before the first training presentation, participating Soldiers received a roster number that was used to identify them throughout the experiment. They were then administered a demographic questionnaire. The initial NVD training was accomplished in a classroom setting. A representative from the U.S. Army Research Laboratory's Human Research and Engineering Directorate presented a night fighting course in the fundamentals of aided and unaided night vision. During this presentation, the Soldiers were taught the key elements of night vision and I<sup>2</sup> technology, how to focus NVDs using a visual acuity resolution chart, how to adjust the helmet mounts, and the fundamentals of night movement techniques. The Soldiers were also trained to turn down the thermal and use the higher resolution I<sup>2</sup> mode of the ENVG to identify human targets after they were detected. The ARL representative also trained the Soldiers in the use of the AN/PVS-14 NVD.

After the completion of the fundamental night training, the contractor for the prototype ENVG presented a course on ENVG prototype. This course included operation and adjustment of the prototype system, as well as suggestions for operational employment of the NVD and what settings should be used in different visibility conditions. Upon completion of the prototype NVD training, Soldiers were given a questionnaire designed to assess their perception of the training adequacy. Questions about system operating procedures, level of detail presented, adequacy of training aids, and length of training were asked.

### **2.4.2 Woodland IMT Course Trials**

Half of the Soldiers used the I<sup>2</sup> device first and half used the ENVG first. Times to complete each obstacle, as well as times to complete the total course, were recorded. At the completion of the exercises with each of the baseline and ENVG prototypes, a subjective questionnaire was administered. In addition, data collector observations were recorded after each trial. If specific obstacles or positions were more difficult or time consuming to execute, the reasons were determined and documented so that corrective actions could be taken in equipment design or procedures.

### 2.4.3 MOUT Target Detection Trials

During this event, the Soldier moved along the control route to the observation points and scanned his assigned sector. When the Soldier detected a target, he identified the target by placing his aiming light on it and telling the data collector. The data collector recorded the target detection and time required to detect the target after ensuring that the correct identification was made. The data collector then instructed the Soldier to continue. The Soldier was presented with ten targets throughout the lane. Half of the Soldiers used the I<sup>2</sup> device first and half used the ENVG first. After each iteration, questionnaires were issued to the Soldiers to address the effectiveness of the system in detecting targets in an urban environment.

### 2.4.4 Land Navigation Course

Soldiers negotiated the land navigation course individually with the baseline and the two prototype NVDs, as shown in table 8. The sequence of the NVDs and lanes was randomized. A data collector followed the Soldier through the course and recorded time to complete the course, the number of times the Soldier left the course because of errors in navigation, the distance the Soldier stopped from the course end point, and any mishaps that occurred. If the Soldier veered off course more than 20 meters, the data collector re-directed him toward the center of his lane. The trial ended when the Soldier reached the end point. After each iteration, questionnaires were issued to the individual to address the effectiveness of the system during the land navigation course.

Table 8. Land navigation course.

Roster	Iteration 1		Iteration 2	
	NVD	Lane	NVD	Lane
9, 11, 38, 39, 42, 63, 71	AN/PVS-14	1	ENVG	2
16, 35, 51	AN/PVS-14	1	ENVG	3
23, 27, 31, 48, 49, 52, 53, 64	AN/PVS-14	2	ENVG	1
12, 44, 45, 60	AN/PVS-14	2	ENVG	3
8, 15, 28, 68	AN/PVS-14	3	ENVG	1
2, 4, 19, 26, 56, 57, 65	AN/PVS-14	3	ENVG	2
13, 29, 37, 59, 62, 67, 70, 72	ENVG	2	AN/PVS-14	1
5, 22, 25, 34, 36, 66	ENVG	3	AN/PVS-14	1
6, 18, 32, 33, 46, 47, 54	ENVG	1	AN/PVS-14	2
7, 14, 30, 40, 43, 69	ENVG	3	AN/PVS-14	2
10, 41, 58	ENVG	1	AN/PVS-14	3
1, 3, 17, 20, 21, 24, 50, 55	ENVG	2	AN/PVS-14	3

### 2.4.5 MOUT Attack and Defend Trials

During this event, a squad defended buildings B4 and B2 in the McKenna MOUT site from an attack from the southeast direction. There were three civilians interspersed with the defenders in predetermined positions. Five data collectors accompanied the defenders to record location and number of targets detected and engaged. A second squad served as the attackers. The attackers

moved to a concealed point to establish a plan for the attack. Smoke was deployed to cover their movement across the open area. Five data collectors accompanied the attackers to record the distance at which they were detected, recognized, and engaged. All data collectors recorded the locations where Soldiers were killed. Sensor gear with blank ammunition was used to determine engagements and kills. The mission was terminated when all the attackers were wounded or killed or when all surviving attackers reached the final objective.

Each group of two squads performed six iterations of the attack-defend scenario; each squad served as the attackers three times and as the defenders three times. The assignment of NVDs was randomized, with the restriction that the opposing squads always wore different NVDs. After each run, questionnaires were issued to the Soldiers to address the effectiveness of the system in detecting targets in an urban setting.

#### **2.4.6 Night Qualification Live Fire Trials**

The test Soldiers fired a modified practice and record qualification scenario with the ENVGs and the baseline NVD. The modified range scenario required the Soldier to engage 20 targets from the foxhole firing position and 20 targets from the prone supported position. Target ranges varied from 50 to 250 meters. This exercise was also used to document the Soldiers' ratings of the NVDs when used in the standing supported and prone supported positions. Half of the Soldiers fired first with the ENVGs and half fired first with the PVS-14s.

A malfunction on the firing range prevented the second group (squads 3 and 4) from participating in the night qualification exercise.

#### **2.4.7 Ambush and Patrol Trials**

Fire teams executed a linear hasty ambush. The ambush fire team was required to move from a secured location into their ambush location without being detected. The patrol fire team conducted a tactical patrol along a given route. The ambush team executed the ambush when the patrol reached the kill zone. The two fire teams alternated the roles of the ambush team and the patrol team during subsequent iterations. Data collectors, who accompanied the patrol and ambush teams, recorded the distances at which the opposing fire teams detected one another. Sensor gear was used to document successful target engagements.

Squads 1 through 6 each conducted eight iterations, with the fire teams alternating in the roles of the patrol team and ambush team (see table 9). Squads 7 and 8 were unable to complete the ambush and patrol trials because of heavy rain. NVDs were randomly assigned to the fire teams, with the restriction that the opposing teams always wore different NVDs. The six ambush sites were randomly assigned.



Table 9. Treatment assignment, ambush, and patrol trials.

Iteration	Site	Squad 1			Squad 2	
		Ambush Team	Patrol Team		Ambush Team	Patrol Team
1	6	FT1 B	FT2 A			
2	2	FT2 A	FT1 B			
3	6				FT2 B	FT1 A
4	4				FT1 A	FT2 B
5	1	FT2 B	FT1 A			
6	4				FT1 A	FT2 B
7	2	FT1 A	FT2 B			
8	1				FT2 B	FT1 A
Iteration	Site	Squad 3			Squad 4	
		Ambush Team	Patrol Team		Ambush Team	Patrol Team
1	6	FT1 A	FT2 B			
2	5				FT1 B	FT2 A
3	6				FT2 A	FT1 B
4	3	FT2 B	FT1 A			
5	6				FT2 A	FT1 B
6	6	FT2 B	FT1 A			
7	4				FT1 B	FT2 A
8	4	FT1 A	FT2 B			
Iteration	Site	Squad 5			Squad 6	
		Ambush Team	Patrol Team		Ambush Team	Patrol Team
1	6				FT1 B	FT2 A
2	3				FT2 A	FT1 B
3	5	FT2 B	FT1 A			
4	2	FT1 A	FT2 B			
5	5	FT1 A	FT2 B			
6	6	FT2 B	FT1 A			
7	6				FT2 B	FT1 A
8	1				FT1 A	FT2 B

#### 2.4.8 Human Factors Engineering Trials

The HFE trials consisted of donning and doffing trials and compatibility trials with clothing, equipment, and firing positions. The form, fit, and function exercise included mounting and dismounting the baseline and prototype devices on and from the helmet. Compatibility with clothing and equipment and the ability to assume standard (stationary) firing positions was also assessed. Dismounted firing positions that were assessed with the NVDs were kneeling, prone, and standing positions. Soldiers wore their standard fighting loads during all trials. Trials also included accessing and operating weapon and prototype device controls in the various firing positions while different ensembles were worn. Protective eyewear and environmental protective clothing were assigned, as shown in table 10. Each Soldier was scheduled to use both NVDs in combination with two of the three equipment conditions: the M40 protective mask, the

Ballistic Laser Eyewear Protective System (BLEPS), and the sun/wind/dust (SWD) goggles. However, the M40 mask was not available for the first group (squads 1 and 2). Within each equipment-NVD condition, the Soldier assumed the three standard firing positions. Soldiers completed a subjective questionnaire after they performed the tasks using the clothing and equipment combinations for the mounting and dismounting event and after the compatibility event.

Table 10. NVD and equipment compatibility trials.

Roster	Iteration			
	1		2	
5, 10, 11, 12, 16	AN/PVS-14	SWD		
8, 14	AN/PVS-14	BLEPS		
1, 2, 3, 7, 13	ENVG	SWD		
6, 18	ENVG	BLEPS		
9, 15, 33, 39, 57, 63	AN/PVS-14	SWD	ENVG	BLEPS
35, 40, 59, 64	AN/PVS-14	SWD	ENVG	M40
4, 17, 20, 28, 41, 44, 52, 65, 68	AN/PVS-14	BLEPS	ENVG	SWD
23, 47, 71	AN/PVS-14	BLEPS	ENVG	M40
24, 25, 31, 48, 49, 55, 72	AN/PVS-14	M40	ENVG	SWD
30, 54	AN/PVS-14	M40	ENVG	BLEPS
26, 27, 37, 50, 51, 61	ENVG	SWD	AN/PVS-14	M40
22, 46, 70	ENVG	BLEPS	AN/PVS-14	SWD
21, 42, 45, 66, 69	ENVG	BLEPS	AN/PVS-14	M40
19, 29, 34, 36, 43, 53, 58, 60, 67	ENVG	M40	AN/PVS-14	SWD
32, 28 56, 62	ENVG	M40	AN/PVS-14	BLEPS

## 2.5 Experimental Design

This test uses a within-subject design. In some of the exercises (woodland IMT trials, MOUT target detection trials, land navigation course trials, night qualification live fire, and HFE trials), the unit of analysis is the individual Soldier. In the other exercises (MOUT attack and defend mission, hasty ambush and patrol mission), the squad is the unit of analysis.

### 2.5.1 Independent Variable

The independent variable was the type of NVD (the ENVG prototype and the baseline NVD) worn during the various exercises.

### 2.5.2 Dependent Variables

The dependent variables for each trial were

- Woodland IMT Trials
  - Time required to complete the overall IMT course with baseline and prototype NVDs.
  - Time required to complete each individual obstacle within the IMT course with baseline and prototype NVDs.

- Number of targets detected with the baseline and prototype NVDs.
- Soldiers' overall ratings of the IMT course negotiation with baseline and prototype NVDs.
- MOUT Target Detection Trials
  - Time required to complete the MOUT target detection course with the baseline and prototype NVDs.
  - Number of targets detected with baseline and prototype NVDs.
  - Time required to detect targets
  - Number of false target detections
  - Soldiers' overall rating of the baseline and prototype NVDs for target detection within a MOUT environment.
- Land Navigation Course
  - Time required to complete the land navigation course with baseline and prototype NVDs.
  - Number of course corrections from the data collector.
  - Distance off course and end point with baseline and prototype NVDs
  - Soldiers' overall ratings of ease of completing the land navigation course with baseline and prototype NVDs.
- MOUT Attack and Defend Mission
  - Number of wounded in action (WIA) and killed in action (KIA) among the attacking and defending squads
  - Distance from objective of WIA or KIA attackers
  - Number of WIA or KIA among the civilians on the battlefield
  - Soldiers' overall ratings of ease of completing the MOUT defense exercise with baseline and prototype NVDs.
- Night Qualification Live Fire
  - Soldiers' qualification scores
  - Number of targets hit at each range of the qualification course
  - Soldiers' overall ratings of ease of detecting and engaging targets with baseline and prototype NVDs.

- Hasty Ambush and Patrol Mission:
  - Distance of detection of the ambush team by the patrol team
  - Distance of detection of the patrol team by the ambush team
  - Number of WIA and KIA among the attacking and defending squads
  - Soldiers' overall ratings of ease of executing an ambush and defending against an ambush with baseline and prototype NVDs.
- Human Factors Engineering Trials.
  - Time required to don the NVDs.
  - Time required to doff the NVDs.
  - Number and type of errors made during donning and doffing.
  - Soldiers' ratings of the ease of donning and doffing.
  - Compatibility problems with clothing.
  - Compatibility problems with equipment.
  - Compatibility problems with firing positions.

### 2.5.3 Data Analysis

Descriptive statistics (means and standard deviations) were used to summarize objective performance data as well as subjective Soldier questionnaire responses. Performance data were analyzed using paired samples t-tests. Partial  $\eta$  squared ( $\eta^2_p$ ), a measure of effect size, was calculated for each t-value. A non-parametric test ( $\chi^2$ ) was used to analyze the map-reading data from the land navigation exercise. Relationships between reported thermal-I<sup>2</sup> mix and performance measures were analyzed with the Pearson coefficient of correlation. Data analysis procedures are summarized in table 11.

Table 11. Data analysis procedures.

Data source	Descriptives	Paired samples t	$\eta^2_p$	$\chi^2$	Pearson r
Soldier questionnaires	x				
Woodland IMT	x	x	x		
MOUT Target Detection	x	x	x		
Land Navigation times	x	x	x		
Land navigation map reading				x	
MOUT Attack and Defend	x	x	x		
Qualification fire	x	x	x		
Ambush and Patrol	x	x	x		
Compatibility	x	x	x		
Mix question and performance variables	x				x

## **2.6 Limitations**

Not all Soldiers were able to complete every task because of such problems as personal and family illness. One group did not complete the night qualification firing because of a range malfunction, and a range computer malfunction precluded one group from receiving a listing of their hits by range. One group did not complete the woodland IMT course because a Federal holiday reduced the number of days available for testing. The resulting attenuated sample sizes decrease statistical power.

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## **3. Results**

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### **3.1 Training and Demographics**

#### **3.1.1 Training**

The Soldiers rated the training they received on the baseline and prototype NVDs as good to very good.

#### **3.1.2 Demographics**

The average time in service for the Soldiers was 37 months, and their rank ranged from E-1 to E-6. The weight of the Soldiers ranged from the 6th to the 99th percentile. Their height ranged from the 9th to the 99th percentile. All but six of the Soldiers had previous experience with NVDs. Twenty-two wore prescriptions lenses. The detailed results from the demographic questionnaire are given in appendix G.

### **3.2 Woodland IMT**

The configuration of the ENVG prototype had no negative impact on IMT obstacle and course negotiation times.

Only 46 of the 72 Soldiers were able to participate in the woodland IMT trials. The mean times for each of the 10 events are shown in table 12. The entry for “Total Events” does not include the data from the three target acquisition events (combat roll, kneel, and prone) since these three events included target acquisition times, and the large variances in the acquisition times tended to obscure the times required to complete the physical obstacles. The “Total Course” entry does contain the target acquisition events, plus the time spent moving from one event to the next. If an NVD malfunctioned, the clock was stopped until the problem was fixed.

Table 12. Time to complete the woodland IMT course.

Event	AN/PVS-14		ENVG	
	Mean	SD	Mean	SD
Pipe Crawl	10.2	2.4	10.6	3.4
Zigzag	7.3	1.3	7.4	1.7
2ft Jump	2.2	0.9	2.3	0.7
Hill	6.3	1.6	6.4	1.6
Low Crawl	38.3	13.6	38	13.4
Roll	34.2	14.2	32.7	14.3
High Crawl	30.9	10.4	29.0	8.9
Kneel	11.6	6.8	12.5	7.1
High Wall	3.0	0.7	3.3	1.8
Prone	16.3	7.06	15.4	7.58
Total Events	98.3	25.4	97.0	24.8
Total Course	216.7	49.9	213.1	51.4

As shown in table 13, a series of paired samples t-tests indicated that there were no significant differences between the devices on any of the events or on the event and course totals.

Table 13. Paired samples t-tests, woodland IMT event times.

Event	t	df	p	$\eta^2_p$
Pipe Crawl	1.11	45	0.271	0.03
Zigzag	0.24	45	0.809	< .01
2ft Jump	0.22	45	0.825	< .01
Hill	0.88	45	0.381	0.02
Low Crawl	0.25	45	0.808	< .01
Roll	0.74	45	0.466	0.01
High Crawl	1.75	45	0.088	0.06
Kneel	0.75	45	0.455	0.01
High Wall	1.44	45	0.157	0.04
Prone	0.72	45	0.472	0.01
Total Events	0.65	45	0.518	0.01
Total Course	0.63	45	0.531	0.01

During the woodland IMT course trials, there was one malfunction with the baseline I<sup>2</sup> device and nine malfunctions with the ENVG. Malfunctions included the NVD becoming detached from the helmet mount, the battery box becoming detached, or the batteries spilling out of the battery box.

In three of the woodland IMT events (combat roll, kneel, and prone), the Soldiers were directed to acquire a human target. The summary statistics on target acquisition are presented in table 14. There was no significant difference among the devices in terms of number of targets acquired.

Table 14. Number of Soldiers acquiring one, two, or three targets (of three) in woodland IMT.

NVD	1	2	3
AN/PVS-14	1	7	38
ENVG	0	8	38

### 3.2.1 Woodland IMT Questionnaire Results

One Soldier commented that depth perception with the prototype NVD hindered his performance on the 2-foot jump, the hill, and the high wall. This was consistent with a non-significant trend for slightly higher mean times on the hill and high wall with the prototype NVD than with the baseline NVD.

During the first seven-day test period, the battery boxes of the ENVG frequently opened. The device had push button releases at the bottom of the battery pack. When Soldiers assumed the prone position (either in the high or low crawl or during the combat roll obstacle), the push buttons were activated when they came in contact with the Soldiers' PASGT vests as their necks moved back. Contractors for the prototype NVD were able to implement a field-expedient solution to this problem, and it was not an issue during the subsequent three IMT test periods.

One Soldier noted that when he jumped down from the high wall, the battery compartment of the ENVG prototype opened and the batteries spilled. Examination of the battery box revealed that this would not have happened if the battery box had been properly closed. However, if only one corner of the battery box was snapped down, a sharp jolt opened the box. Some of the Soldiers noted that the brightness control of the ENVG prototype was easily bumped out of position during movement.

The thermal capability of the prototype NVD made no significant difference in the Soldiers' performance on the three target detection tasks in this course. This can be attributed to four factors. First, all targets were backlit by the lights from the nearest city, and low light levels were not a factor. Second, several of the Soldiers stated that the thermals were not working on their ENVG during this course so they only had I<sup>2</sup> capability or no capability. (If the thermal cut off temporarily, it went into the initialization mode when it came back on and blocked the entire screen.) Third, most of the Soldiers used a thermal-I<sup>2</sup> mix that was primarily I<sup>2</sup>. Fourth, there was a ceiling effect. Even if all Soldiers had detected all three targets with the ENVGs, the effect would not have been statistically significant.

Detailed results from the Soldier questionnaires are given in appendix G.

### 3.3 MOUT Target Detection

The prototype ENVG had no adverse impact on the completion times of the MOUT target detection course. Soldiers detected significantly more thermal and human targets with the fused NVD than with the I<sup>2</sup> baseline device. Detection of the cold (non-thermal) targets was best with the I<sup>2</sup> baseline device.

Table 15 shows the mean times to complete the MOUT target detection course with each NVD type. A paired samples t-test yielded no significant effect for NVD type:  $t(df=71) = 0.74$ ,  $p = 0.46$ ,  $\eta_p^2 = 0.01$ .

Table 15. Course completion times (seconds), MOUT target detection.

NVD	Total Time (min:sec)	
	Mean	SD
AN/PVS-14	6:33	1:49
ENVG	6:22	1:39

Table 16 shows the mean times to detect the targets. Each undetected target was encoded as having a 45-second detection time. A summary of the paired samples t-tests is shown in table 17. Detection times were significantly faster with the ENVG prototype for thermal and human targets. Detection times for cold targets, however, were significantly faster when the Soldiers were using the baseline I<sup>2</sup> NVD.

Table 16. Target detection times (seconds), MOUT target detection.

NVD	Overall		Thermal Target		Cold Target		Human Target	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
AN/PVS-14	15.9	7.86	17.7	10.8	16	12.1	16.4	9.71
ENVG	11.9	5.59	8.3	7.33	20.3	10	9.58	6.41

Table 17. Paired samples t-tests, MOUT target detection times.

Target	t	df	p	$\eta^2_p$
Thermal	6.60	71	< .001*	.38
Cold	2.37	71	.021*	.07
Human	5.34	71	< .001*	.29

\* $p < .05$ , two-tailed

There were 10 targets on each of the three iterations, for a total of 30 targets. There were 14 human targets, 8 thermal targets, and 8 cold targets. Table 18 shows the mean percentage of thermal, cold, and human targets detected. As indicated in table 19, significantly more thermal and human targets were detected with the prototype ENVG. For the cold targets, a significantly higher proportion of targets was detected with the I<sup>2</sup> baseline system.

Table 18. Percentage of targets detected, MOUT target detection.

NVD	Overall		Thermal Target		Cold Target		Human Target	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
AN/PVS-14	77.8	16.7	70.9	27.6	79.5	28.1	76.9	21.7
ENVG	86.9	12.1	95.8	16.3	66.9	25.8	93.6	18.8



Table 19. Paired samples t-tests, MOUT target detection percentages.

Target	t	df	p	$\eta^2_p$
Thermal	7.16	71	< .001*	.42
Cold	2.83	71	.006*	.10
Human	4.55	71	< .001*	.23

\* $p < .05$ , two-tailed

### 3.3.1 MOUT Target Detection Questionnaire Results

The Soldiers commented that while moving, it was simple to adjust the thermal- $I^2$  mix with the ENVG prototype device because there was only one control and it could be operated with one hand. Their ratings for their ease of target detection were higher for the ENVG than for the AN/PVS-14; this is consistent with the significantly faster target detection times for “hot” targets with the ENVG. Soldiers complained that it was very difficult to see targets in doorways and windows, especially in dark areas, with the  $I^2$  baseline device. Soldiers tended to use an equal mix of  $I^2$  and thermal for the fused devices during this exercise. They commented that fusion allowed them to see the detail for movement through the MOUT course and to easily see targets in dark areas of the course. However, a few Soldiers expressed concern that the outer edges of the ENVG image were blurred. Soldiers also mentioned that the lag time with the ENVG thermal during scanning caused them some problems.

Soldiers complained that the mount for the AN/PVS-14 was unstable and that it “wobbled” (mostly because of the swing arm). They also complained that the front of the AN/PVS-14 was too long and heavy.

During the first seven-day period, Soldiers complained that the battery box for the ENVG prototype kept falling off. The field-expedient solution (turning the battery box in its mount 180 degrees) by the contractor representative greatly reduced the frequency of this problem after the first period. However, Soldiers continued to complain about the thermal overlay cutting off and recycling. Detailed results from the Soldier questionnaires are shown in appendix G.

### 3.4 Land Navigation

The fused NVDs did not interfere with night land navigation performance. Soldiers were able to perform land navigation successfully with all three devices. Most Soldiers were able to read the map grid coordinates using the AN/PVS-14 device but not with the prototype ENVG.

Table 20 displays the mean land navigation course completion times. A paired samples t-test yielded no significant effect for NVD type:  $t(df=67) = 0.36$ ,  $p = 0.723$ ,  $\eta^2_p < 0.01$ .

Table 20. Course completion times, land navigation course.

NVD	Total Time (min:sec)	
	Mean	SD
AN/PVS-14	18:47	5:51
ENVG	19:03	6:59

Table 21 displays the mean number of times the Soldiers veered 20 m or more off course with each device type. A paired samples t-test yielded no significant effects for NVD:  $t(df=70) = 0.75, p = 0.46, \eta_p^2 < 0.01$ .

Table 21. Mean number of times veered off course, land navigation course.

<b>NVD</b>	<b>Mean</b>	<b>SD</b>
AN/PVS-14	0.77	0.81
ENVG	0.87	0.91

Table 22 displays the mean distance the Soldiers ended from the correct course end point. A paired samples t-test yielded no significant effects for NVD type:  $t(df=69) = 0.38, p = 0.700, \eta_p^2 < 0.01$ .

Table 22. Mean distance from end point, land navigation course.

<b>NVD</b>	<b>Distance (meters)</b>	
	<b>Mean</b>	<b>SD</b>
AN/PVS-14	14.1	24.4
ENVG	15.8	27.6

At the end of each land navigation iteration, each of the 72 Soldiers was asked to use the NVD to identify the eight-digit grid coordinates for a point on a map. Table 23 shows the percent of Soldiers who were able to read the map coordinates with each device. Map reading was scored as correct or incorrect. Soldiers did significantly better with the I<sup>2</sup> baseline device than with the ENVG:  $\chi^2(df=1) = 26.9, p < 0.001$ .

Table 23. Percentage of Soldiers able to read map coordinates.

<b>NVD</b>	<b>Percent</b>
AN/PVS-14	76.4
ENVG	31.9

### 3.4.1 Land Navigation Questionnaire Results

Soldiers rated movement over the terrain between easy and neutral for both NVDs. However, the minimum focusing distance of the ENVG was not sufficient for reading the map and compass. One Soldier stated that placing the pinhole cover over the lens of the ENVG prototype enabled him to read the map and compass. For this exercise, most Soldiers used very little thermal. There were numerous complaints concerning fogging with both NVDs.

Detailed results from the Soldier questionnaires are presented in appendix G.

### 3.5 MOUT Attack and Defend Exercise

For the defending squads, the use of the fused NVDs, relative to the I<sup>2</sup> baseline device, doubled the effective kill range.

Table 24 shows the proportion of defenders and civilians who were killed or wounded by the attacking squad. For both defender and civilian casualties, the proportion of variance accounted for by the NVDs was trivial. For the defender casualties data,  $t(df=7) = 0.03$ ,  $p = 0.976$ ,  $\eta_p^2 < 0.01$ , while the for the civilian casualties  $t(df=7) = 0.43$ ,  $p = 0.683$ ,  $\eta_p^2 = 0.02$ .

Table 24. Proportion of casualties inflicted by the attack squad.

NVD	Percent Defenders KIA/WIA		Percent Civilians KIA/WIA	
	Mean	SD	Mean	SD
AN/PVS-14	0.75	0.22	0.25	0.34
ENVG	0.74	0.28	0.18	0.24

Table 25 shows the proportion of attackers killed or wounded by the defending squads using the two NVDs. The type of NVD used accounted for only a trivial proportion of the variance:  $t(df=7) = 0.39$ ,  $p = 0.708$ ,  $\eta_p^2 = 0.02$ .

Table 25. Proportion of casualties inflicted by the defending squad.

NVD	Percent Attackers KIA/WIA	
	Mean	SD
AN/PVS-14	0.70	0.13
ENVG	0.68	0.12

Table 26 shows the mean maximum range for a kill inflicted on the attacking squad by the defenders. The range with the ENVG prototype was significantly greater than the range with the I<sup>2</sup> device:  $t(df=5) = 3.16$ ,  $p = 0.025$ ,  $\eta_p^2 = 0.67$ . The defenders were able to successfully engage the attackers at almost double the range when they used fused NVD versus the I<sup>2</sup> baseline device.

Table 26. Maximum range of successful target engagement by the defending squad.

NVD	Maximum Range (m) to Kill	
	Mean	SD
AN/PVS-14	25.8	24.0
ENVG	49.2	18.0

#### 3.5.1 MOUT Attack and Defend Questionnaire Results

The thermal capability of the ENVG enhanced the Soldiers' ability to fight in smoke by increasing the distance at which they could engage targets.

The MOUT attack required the Soldiers to move between light and dark areas and between smoke and no smoke and required movement as well as target engagement. All these different tasks and conditions resulted in the need for frequent NVD adjustment.

There were several complaints that the thermals of the ENVG prototypes were recycling, which put a test pattern on the screen, blocking the Soldiers' view.

Soldiers commented that defensive operations with the ENVGs were easier than offensive operations. Defensive operations did not require as much refocusing of the NVDs and Soldiers were able to increase the thermal in the mix for effective target detection since they did not have to worry as much about movement.

Detailed results from the Soldier questionnaires are given in appendix G.

### 3.6 Night Qualification Live Fire

Firing accuracy was better for cold (non-thermal) targets with the I<sup>2</sup> baseline device than with the fused NVD. There was no significant difference between the NVDs for the thermal targets.

During the qualification firings, there were several problems with the thermal blankets on the "pop-up" targets. Some of the blankets failed to operate, and some failed to generate the full heat level.

Table 27 shows the mean number of hits at each range for both target types combined and the total hits for each NVD. At the 50-m range, there was a statistically higher hit rate among for the AN/PVS-14 than for the ENVG:  $t(df=33) = 2.65, p = 0.012, \eta_p^2 = 0.18$ . There was no significant difference between the NVDs in terms of total hits:  $t(df=51) = 0.65, p = 0.520, \eta_p^2 = 0.01$ .

Table 27. Mean hits by ranges.

NVD	n	Target Range (m)										Total	
		50		100		150		200		250			
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
AN/PVS-14	35	2.17	1.74	2.46	2.8	1.46	1.65	0.54	1.04	0.06	0.24	6.45	5.29
ENVG	35	1.43	1.44	1.97	2.16	1.4	2.1	0.46	0.7	0.23	0.49	5.94	5.21

The 50-m targets were non-thermal, while all the other targets were thermal. In table 28, the hits are summarized by cold versus thermal targets. There was no significant difference among the NVDs for the thermal targets  $t(df=33) = 0.61, p = 0.548, \eta_p^2 = 0.01$ . The malfunctions of the thermal blankets may account for the failure of the ENVG to produce enhanced accuracy for thermal targets.

Table 28. Mean hit rates, cold versus thermal targets.

NVD	n	Cold		Thermal	
		Mean	SD	Mean	SD
AN/PVS-14	35	2.17	1.74	4.51	4.48
ENVG	35	1.43	1.44	4.06	4.27

### 3.6.1 Night Qualification Questionnaire Results

Firing from the prone position was difficult with both NVDs because they tended to slide down on the Soldiers' faces. The ENVG battery packs pushed the Soldiers' PASGT helmets up in the back and the helmets did not properly cover the Soldiers' heads. Soldiers noted that when they scanned with the ENVG, there was a lag in the thermal picture, which they described as a "ghost effect". They also complained that the FOV of the ENVG thermal was not wide enough for this firing task. They reported that the thermal targets were much easier to detect with the ENVG prototype than with the AN/PVS-14. The thermal targets tended to grab their attention, resulting in engagements against these targets first, when the cold 50-meter targets were present. One Soldier complained that the ENVG thermal overlay overpowered his I<sup>2</sup> picture, which reduced his hit probability on the cold 50-meter targets. Several Soldiers reported that the ENVG's thermal turned off and on or recycled, which resulted in poor target hit performance. The offset between thermal and I<sup>2</sup> images of the fused NVDs bothered some firers. This offset could potentially reduce hit probability if the Soldier aims at center of mass of the hot spot. The impact of offset position should be studied in a controlled environment. Some Soldiers complained that barrel heat seen through the ENVGs overshadowed the thermal targets. They had no problems seeing the AN/PEQ-2 laser with the ENVGs.

Detailed results from the Soldier questionnaires are given in appendix G.

### 3.7 Hasty Ambush and Patrol

There were no significant differences between NVDs in terms of casualties inflicted or detection range. However, there were numerous reports of malfunctions with the ENVG, which could have interfered with detection.

The values for each NVD were averaged across iterations for the 12 fire teams. Table 29 shows the mean range at which the ambush and patrol teams first detected one another. There was no significant effect for NVD type in the range at which the patrol team detected the ambush team:  $t(df=10) = 0.30, p = 0.769, \eta_p^2 = 0.01$ , nor was there a significant difference between NVDs in the range at which the ambush team detected the patrol team:  $t(df=10) = 1.37, p = 0.204, \eta_p^2 = 0.17$ .

Table 29. Mean detection range (m) for the ambush and patrol teams.

NVD	Patrol Detects Ambush		Ambush Detects Patrol	
	Mean	SD	Mean	SD
AN/PVS-14	21.7	22.8	23.1	14.3
ENVG	24.2	25.5	35.9	24.8

Table 30 shows the proportion of the opposing team killed or wounded by the ambush and patrol teams. For the casualties inflicted by the ambush team, there was no significant effect for NVD

type:  $t(df=10) = 0$ . There was no statistically significant effect for NVD type for the casualties inflicted by the patrol team:  $t(df=10) = 1.42, p = 0.186, \eta_p^2 = 0.17$ .

Table 30. Proportion of KIA plus WIA for the ambush and patrol teams.

NVD	Casualties Inflicted by Ambush Team		Casualties Inflicted by Patrol Team	
	Mean	SD	Mean	SD
AN/PVS-14	0.40	0.32	0.14	0.14
ENVG	0.40	0.45	0.07	0.13

### 3.7.1 Hasty Ambush and Patrol Questionnaire Results

During the patrol, three Soldiers complained that the ENVG turned off during movement. The Soldiers rated ease of target detection during the patrol higher when they used the ENVG rather than the AN/PVS-14. Some Soldiers stated that they were also able to see the muzzle flash with the ENVGs, which sensitized them to target location before they could even see the heat signature of the ambushers.

Soldiers rated the ENVG higher than the AN/PVS-14s for target detection from the ambush position. A few Soldiers complained that the I<sup>2</sup> image of the ENVG was overpowered by the thermal image when it was turned higher for detecting targets at low ranges.

## 3.8 Human Factors Engineering

Donning and doffing times were faster with the AN/PVS-14 than with the ENVG. Problems with the configuration, control systems, and visual characteristics of the fused NVD are identified and discussed.

### 3.8.1 Compatibility Trials

Not all test Soldiers were able to complete the donning and doffing trials with all possible NVD-equipment combinations. Table 31 shows the mean times to don both NVDs with the three different equipment conditions. The independent samples t-tests are summarized in table 32. There were significant effects for each of the three equipment conditions; in each condition, donning times were significantly faster with the I<sup>2</sup> baseline device.

Table 31. Time (seconds) to don NVD.

Equipment	n	AN/PVS-14		ENVG	
		Mean	SD	Mean	SD
M40 Mask	36	33.8	17.2	68.2	32.5
SWD Goggles	49	32.4	35.4	50.7	21.4
BLEPS	34	25.5	15.6	51.7	29

Table 32. Independent samples t-tests, donning times.

Equipment	t	df	p	$\eta^2_p$
M40 Mask	4.07	35	< .001*	.32
SWD Goggles	2.19	48	.033*	.09
BLEPS	3.34	33	.002*	.25

\* $p < .05$ , two-tailed

Summary statistics for the doffing trials are shown in table 33. The independent samples t-tests are summarized in table 34. The differences in doffing times between the NVDs were significant for all three eyewear equipment conditions. As was the case with donning, the Soldiers were able to doff the AN/PVS-14A more quickly than the ENVG.

Table 33. Time (seconds) to doff NVD.

Equipment	n	AN/PVS-14		ENVG	
		Mean	SD	Mean	SD
M40 Mask	36	6.19	2.76	19.2	13.3
SWD Goggles	49	6.39	4.22	18.2	13.5
BLEPS	34	6.12	4.11	18.3	24.1

Table 34. Independent samples t-tests, doffing times.

Equipment	t	df	p	$\eta^2_p$
M40 Mask	4.18	35	< .001*	.33
SWD Goggles	4.26	48	< .001*	.27
BLEPS	2.06	33	.047*	.11

\* $p < .05$ , two-tailed

### 3.8.1.1 Compatibility Questionnaire Results

Soldiers complained that the distance of the M40 mask from their faces pushed both NVDs out so far from their eyes that their FOV was reduced.

The ENVG prototype mounting position was too close to the M40. Because there was not enough adjustment available, several Soldiers complained that they had to tilt their NVDs. One Soldier stated that the tilted NVD did not align with the lenses on the mask.

Detailed results from the Soldier questionnaires are shown in appendix G.

### 3.8.2 Individual Differences in Thermal Mix

A higher thermal component in the  $I^2$ -thermal mix was associated with superior target detection and engagement.

In the questionnaires administered to the Soldiers after each trial, there was an item asking the respondent about the I<sup>2</sup>-thermal mix he had used in the ENVG prototype: “During this trial did you use mainly I<sup>2</sup>, mainly thermal, or an equal mix of the two?”

100% I <sup>2</sup>	Mostly I <sup>2</sup>	Slightly I <sup>2</sup>	Equal Mix	Slightly Thermal	Mostly Thermal	100% Thermal
1	2	3	4	5	6	7

We correlated these mix ratings with all the performance variables. Table 35 shows all the statistically significant correlations between the mix ratings and the performance variables. When squads or fire teams were the unit of analysis, the mean mix ratings were used.

Table 35. Summary of significant correlations between performance measures and Soldiers’ reports of I<sup>2</sup>-thermal mix.

Event	Variable	r	p	n	Comment
Ambush Defense	Percent killed	0.66	0.006	16	The more thermal in the mix, the more casualties inflicted
	Percent killed and wounded	0.61	0.012	16	
MOUT Target Detection	Total percent detected	0.35	0.003	69	The more thermal in the mix, the more targets detected
	Time to detect	-0.35	0.003	69	The more thermal in the mix, the quicker the targets detected

The next three figures depict the significant relationships between the mix ratings and performance measures for the ENVG prototype. Figure 1 shows the proportion of enemy kills in the ambush defense. Greater thermal mix was associated with increased casualties inflicted on enemy combatants. (There was a non-significant trend for higher civilian casualties being associated with greater thermal mix for the ENVG.)

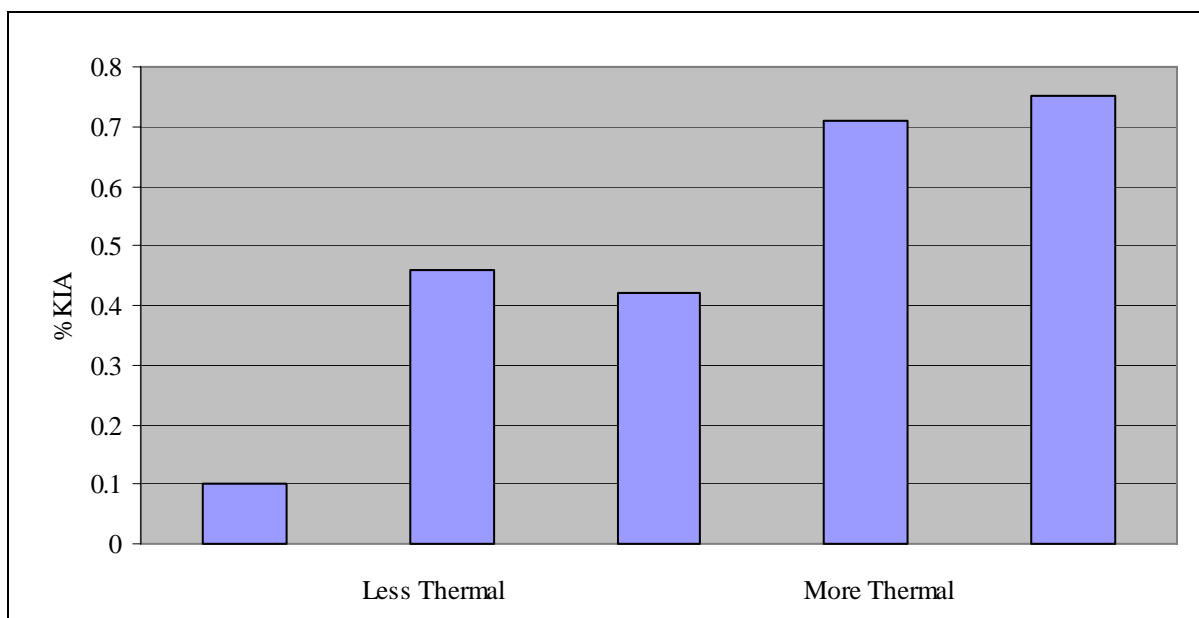


Figure 1. Percent KIA as a function of thermal mix, ambush defense.



Figure 2 shows the relationship between thermal mix ratings for the ENVG and the proportion of targets detected in the MOUT setting. The higher thermal settings were associated with better target detection.

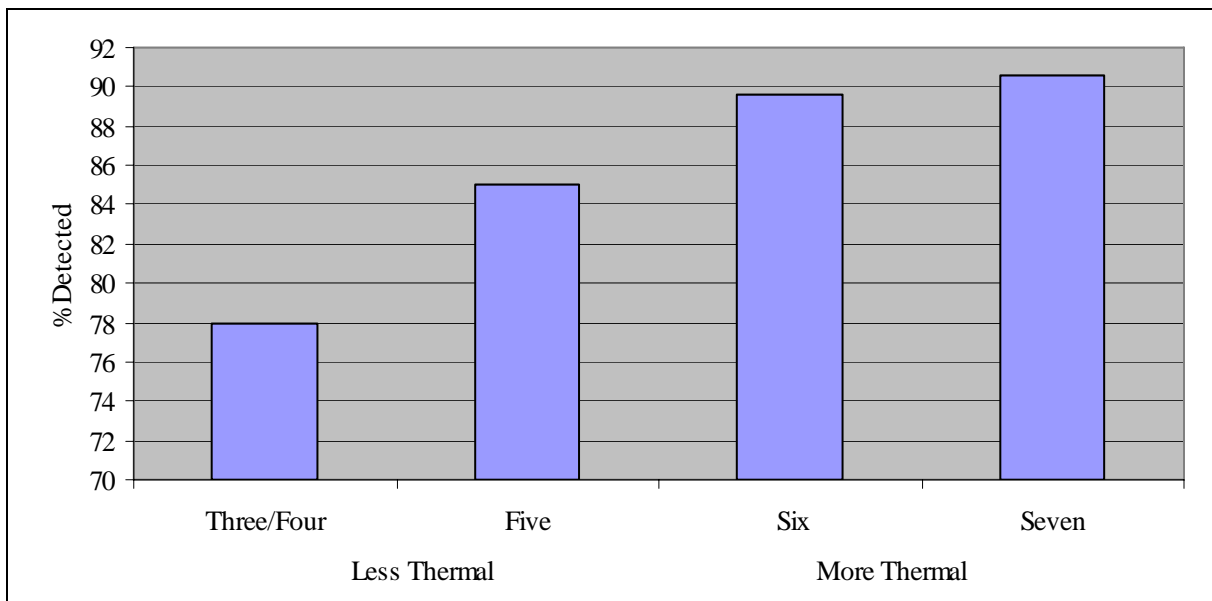


Figure 2. Percent targets detected as a function of thermal mix, MOUT target detection.

Figure 3 shows the relationship between ENVG mix settings and target detection time. Increased use of the thermal overlay was associated with faster detection times.

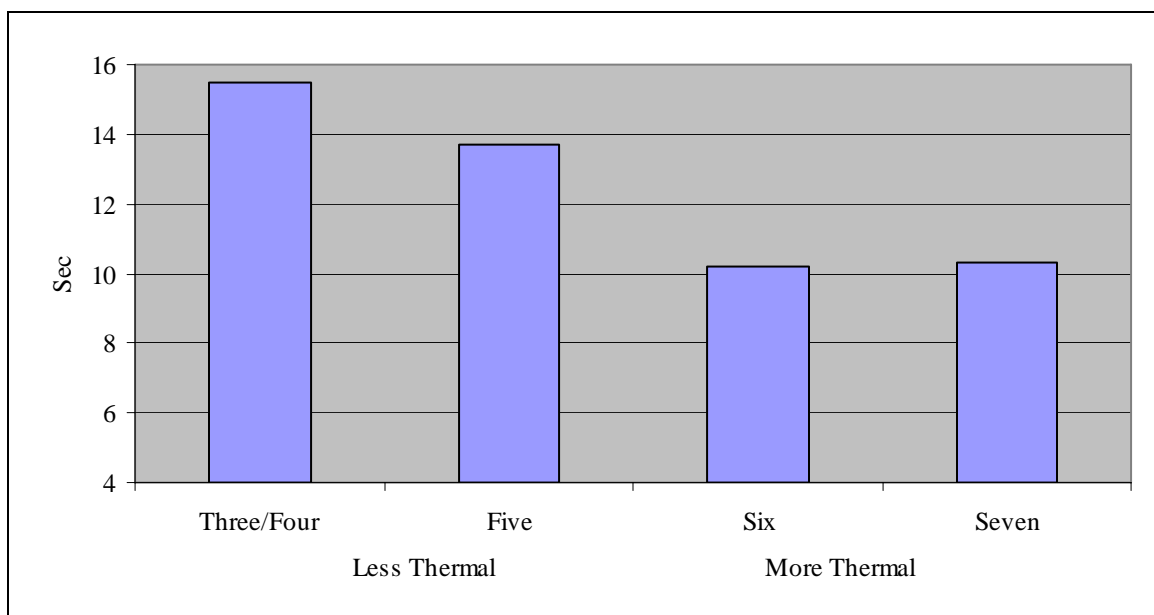


Figure 3. Mean time (seconds) to detect targets, MOUT target detection.

### 3.8.3 Human Factors Engineering Design

#### 3.8.3.1 Configuration

The counterbalance provided by the ENVG battery pack on the back of the helmet appeared to have compensated somewhat for the weight differential between the ENVG and the AN/PVS-14. Night qualification was the only exercise in which the ENVG was rated more than half a point lower (on a seven-point scale) than the AN/PVS-14. The increased weight of the ENVG created difficulty for the Soldiers when they fired from the prone position. The only exercise in which the shape of the ENVG was rated appreciably lower than the I<sup>2</sup> baseline device was the woodland IMT course. In this exercise, the battery box hit the back of the body armor during the low and high crawls and when the prone position was assumed. A field-expedient solution to this issue after the first iteration of the IMT course reduced this problem.

#### 3.8.3.2 Control Design

The location of the I<sup>2</sup> control knob on the ENVG prototype is so close to the objective lens that it is often inadvertently knocked out of position when the lens is focused. This problem is compounded by the fact that the control is extremely easy to turn. The probability of inadvertent activation is much higher when the Soldier wears gloves. The eyecup on the ENVG appears to be glued to the diopter focus ring. Several Soldiers complained about this configuration because it made it difficult or impossible to correctly focus the NVD and position the eyecup teardrop in the correct location. The location of the IR illuminator button next to the thermal off/on/brightness control mix knob is counterintuitive. Moving it to be nearer the I<sup>2</sup> control would be more logical since its function is to provide more light for the I<sup>2</sup> in low light conditions. In its current location, it is difficult to access because it is so close to the thermal control. During high humidity conditions, when the Soldier folds the eyecup back to keep the lens from fogging, the folded eyecup hinders the use of the thermal off/on/brightness control mix knob. This control is also easily knocked out of adjustment because of its proximity to the IR illuminator button and the diopter focus ring and because it is also easily moved out of position.

#### 3.8.3.3 Helmet Mount Design

The ENVG battery pack attachment method was simple but delicate, as was the flip-up helmet mount (“rhino mount”). The plastic was weak and the cover was a problem. The battery connection cord location was poor and the connection needed to be marked better (a red dot on a red line is fine in high light levels but not in other lighting conditions). Soldiers stated that the ENVG helmet mount was compatible with both the PASGT helmet and the advanced combat helmet (ACH).

#### 3.8.3.4 Vision Characteristics

A few Soldiers commented that the I<sup>2</sup> on the ENVG prototype was not bright enough. There were also several comments that the thermal overlay left residual images on the screen, even when the thermal was turned off. Most often, this residual image was in the corners of the thermal screen. One Soldier adamantly stated that objects in the ENVG image seemed farther away than they really were. Several others stated that the edges of the I<sup>2</sup> screen were blurry, even when the center was sharp. The minimum focusing distance of the ENVG was not sufficient for Soldiers to read maps or a compass. However, when the Soldiers used a technique that they currently use with the AN/PVS-14s (placing the daytime cap over the lens), they could read the compass and map.

Many Soldiers complained that their ENVG lost power and the thermal system recycled during their exercise. Recycling resulted in complete loss of vision during the time required to complete the recycling because the thermal recycle screen covered the I<sup>2</sup> image. Thus, many of the Soldiers' exercise results were adversely affected by the somewhat frequent loss of power to the thermal device.

As discussed in the night qualification section of this report, the presence of a "hot spot" or thermal image appears to draw the Soldiers' attention away from cold images that can be seen with only the I<sup>2</sup>. This can be an advantage if the Soldier is required to detect a human target or heat-emitting machinery. This same tendency could be a disadvantage if cold object detection is an important task.

Proper focusing and mix settings are critical to good performance with the ENVG. Some Soldiers were unable to focus and to set the mix properly for the task at hand, and their performance reflected these problems.

Detailed results from the Soldier questionnaires are shown in appendix G.

#### 3.8.4 End of Experiment Questionnaires

At the end of the experiment, the Soldiers were asked which of the two NVDs they preferred on a number of dimensions. In table 36, the NVD preferred by most respondents is indicated by an "X". The Soldiers consistently preferred the ENVG for detection and engagement of heat-emitting targets. They also preferred the ENVG for maneuvering in a MOUT environment, with the caveat that the ENVG is not good for distinguishing civilians from combatants. The Soldiers preferred the AN/PVS-14 with respect to donning and doffing, individual movement, detecting and engaging non-thermal targets, design features, and assuming standard firing positions. Most of the Soldiers said they would rather take the ENVG into combat.

Table 36. Preference for NVDs, end of experiment questionnaire (x = preferred by majority).

Event	Target Detection & Engagement	AN/PVS-14	ENVG
MOUT Target Detection	Detecting targets in windows		X
	Detecting targets in doorways		X
	Scanning buildings for targets		X
Woodland IMT	Scanning for targets		X
	Detecting targets		X
MOUT Attack and Defend	Detecting targets in windows		X
	Detecting targets in doorways		X
Night Qualification	Detecting targets at 150 to 250 m		X
	Engaging targets from foxhole at 150 to 250 m		X
	Engaging targets from prone at 150 to 250 m		X
	Knowing you hit targets at 150 to 250 m		X
Ambush	Detecting targets		X
	Recognizing targets		X
	Engaging targets		X
Event	Donning & Doffing		
Compatibility	Donning with the M40 mask	X	
	Donning with the BLEPS	X	
	Donning with the SWD goggles	X	
	Doffing with the M40 mask	X	
	Doffing with the BLEPS	X	
	Doffing with the SWD goggles	X	
Event	Individual Movement		
Land Navigation	Navigating the terrain	X	
	Reading the map accurately	X	
	Depth perception	X	
Woodland IMT	Going under obstacles	X	
	Going over obstacles	X	
	Going through obstacles	X	
	Navigating the course at a quick pace	X	
Event	Non-Thermal Targets		
Night Qualification	Detecting targets at 50 to 100 m	X	
	Engaging targets from foxhole at 50 to 100 m	X	
	Engaging targets from prone at 50 to 100 m	X	
	Knowing you hit targets at 50 to 100 m	X	
Event	Design Features		
All	Helmet mount design	X	
	Battery box design	X	
	Control knob design	X	
	Other features (e.g., eyecup, weight, bulk, etc.)	X	
Event	MOUT Maneuver		
MOUT Attack and Defend	Approach building in stealth mode		X
	Recognizing civilians in buildings	X	
	Clearing rooms		X
Event	Firing Positions		
Compatibility	Assuming kneeling firing position	X	
	Assuming prone firing position	X	
Event	Question		
All	Which goggle would you take to combat?		X

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## 4. Conclusion

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The fused NVD provided enhanced target detection capability, especially through obscurants, without interfering with movement. Overall results indicate that the fusion capability in the ENVG system significantly increased the ability of the Soldiers to detect targets during both smoke and no-smoke conditions. Fusion diminished the negative impact on target detection when smoke was introduced. In the woodland environment, effective fusion did not interfere with cross-country movement times and did increase the range at which human targets were detected. Deep shadows, camouflage, and smoke did not mask targets when Soldiers used the thermal overlay. In the MOUT setting, fusion provided significantly better detection of human and thermal targets than was provided by the I<sup>2</sup> baseline. Fusion had no impact on target engagement.

When used in the fusion mode, the ENVG devices were compatible with the AN/PEQ-2 laser aiming device. Thus, Soldiers can accurately fire their weapons and get the benefit of thermal target detection capabilities without a thermal weapon sight.

The results of this experiment indicate that fusion NVDs can enhance the ability of the dismounted infantryman to conduct night tactical operations.

There was much variance in individual Soldier performance with the fused NVDs. Proper focusing and mix settings are critical to good performance with these NVDs. Some Soldiers were unable to focus and to set the mix properly for the task at hand, and their performance reflected these problems.

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## 5. Recommendations

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This experiment demonstrated the capability of fusing I<sup>2</sup> and thermal imaging in a single head-mounted NVD. Combining I<sup>2</sup> and thermal in a head-mounted NVD enhances the ability to detect targets at extended ranges without sacrificing the detailed visual information normally associated with I<sup>2</sup> alone. With the addition of thermal, the target detection capabilities were enhanced in battlefield obscurants conditions.

This study also showed that the ENVG device can be configured so that it does not interfere with IMT and traversing rough terrain. The monocular design facilitates movement and Soldier acceptance (Bonnett, Redden, & Carstens, 2005). While the ENVG slightly increases the total weight of the helmet assembly, the placement of the battery pack at the back of the helmet counterbalances the weight distribution, thus reducing head and neck strain.

The mixing and adjusting of the I<sup>2</sup> and thermal images are critical to the effective operation of the ENVG. It is important that the thermal overlay does not obscure the detail provided by the I<sup>2</sup> image. Complex menu systems for fusion adjustment consume time and decrease Soldier acceptance. The incorporation of internal adjustment algorithms, on the other hand, increases performance efficiency. The Soldiers in this study preferred adjustment knobs over buttons or menu adjustment systems. A Soldier should be able to operate all controls with a single hand and while moving.

Care should be taken to ensure that the battery connectors are durable enough to withstand field operation.

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## 6. References

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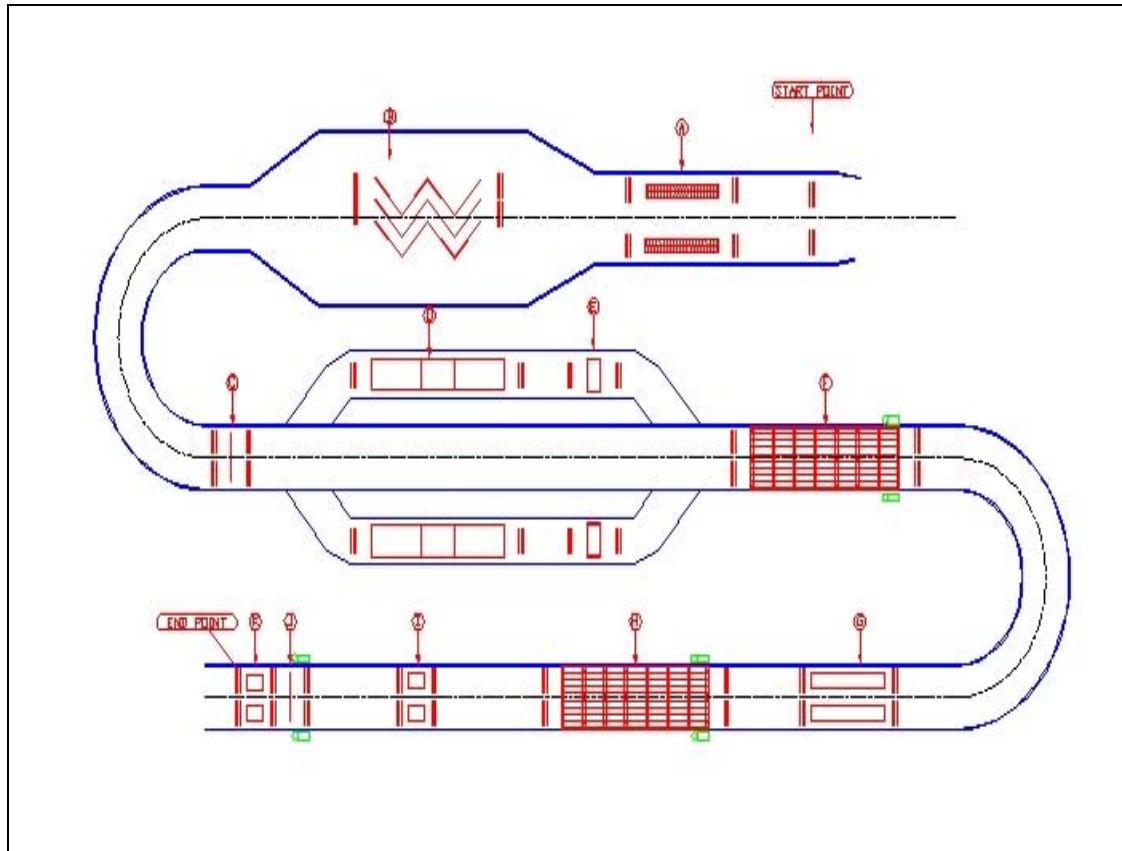
Bonnett, C. B.; Redden, E. S.; Carstens, C. B. *Limited User Evaluation of Enhanced Night Vision Goggles*; ARL-TR-3536; U.S. Army Research Laboratory: Aberdeen Proving Ground, MD, 2005.



United States Army Infantry Center. *Own the Night Master Plan for Dismounted Systems* (unpublished document), 1998.

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## Appendix A. Woodland IMT Course Layout



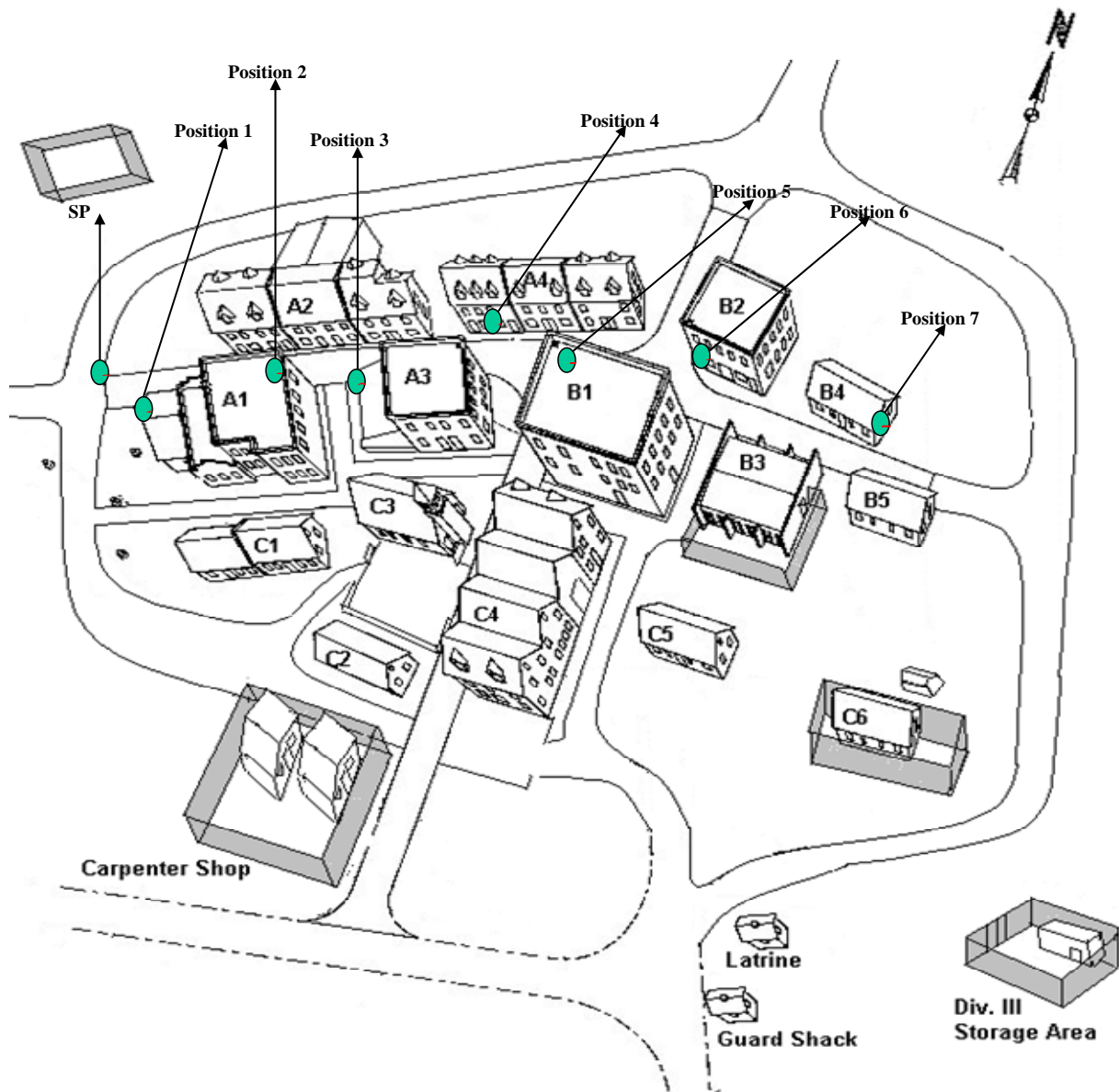
PROPOSED IMT COURSE	
ITEM	OBSTACLE DESCRIPTION
A	PIPE CRAWL
B	ZIG ZAG
C	2 FT JUMP
D	HILL
E	FOX HOLE
F	LOW CRAWL
G	FIRING POSITION
H	HIGH CRAWL
I	FIRING POSITION
J	HIGH WALL
K	FIRING POSITION
	BEAM BREAK SENSOR
	TARGETS

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## Appendix B. MOUT Target Detection Lane Course Layout

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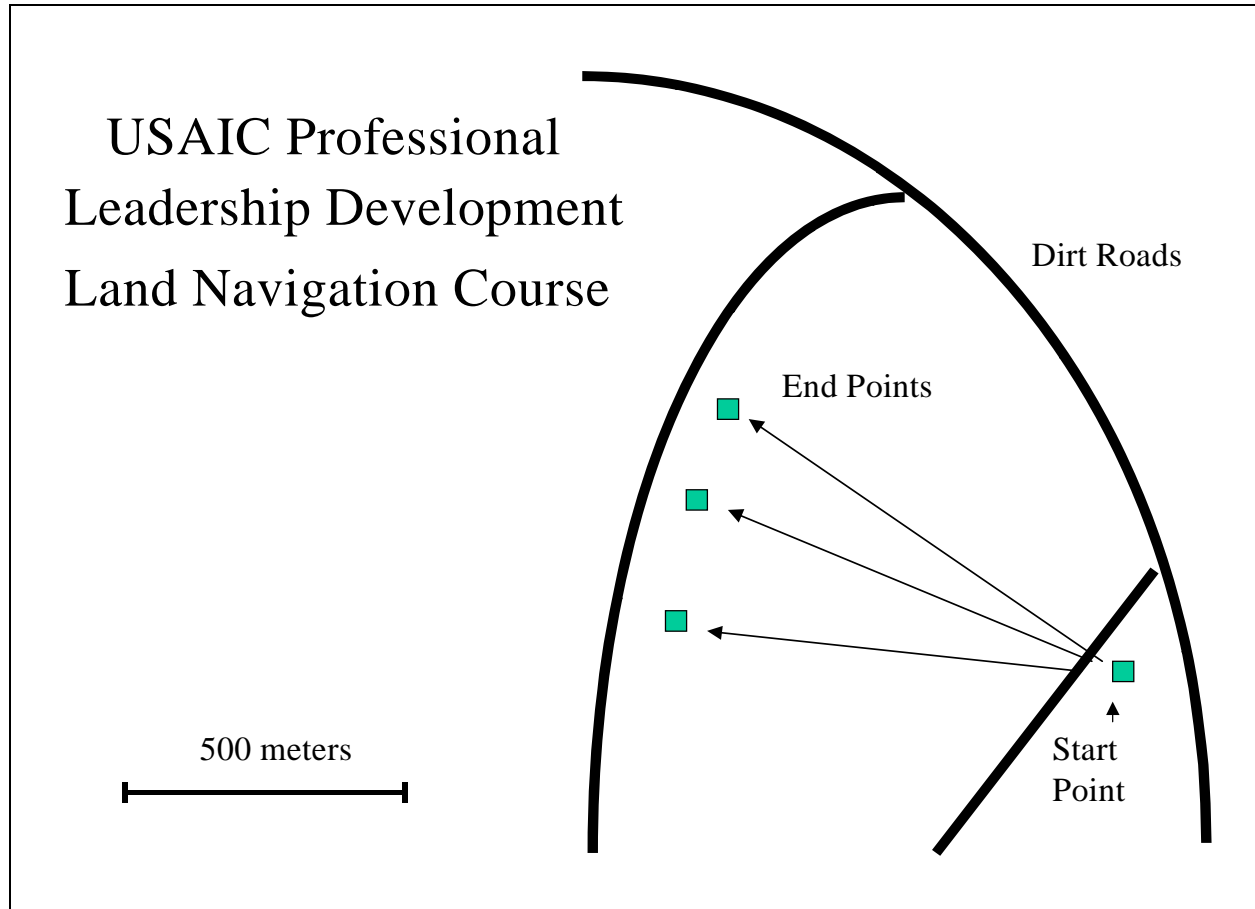


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## Appendix C. Land Navigation Course Layout

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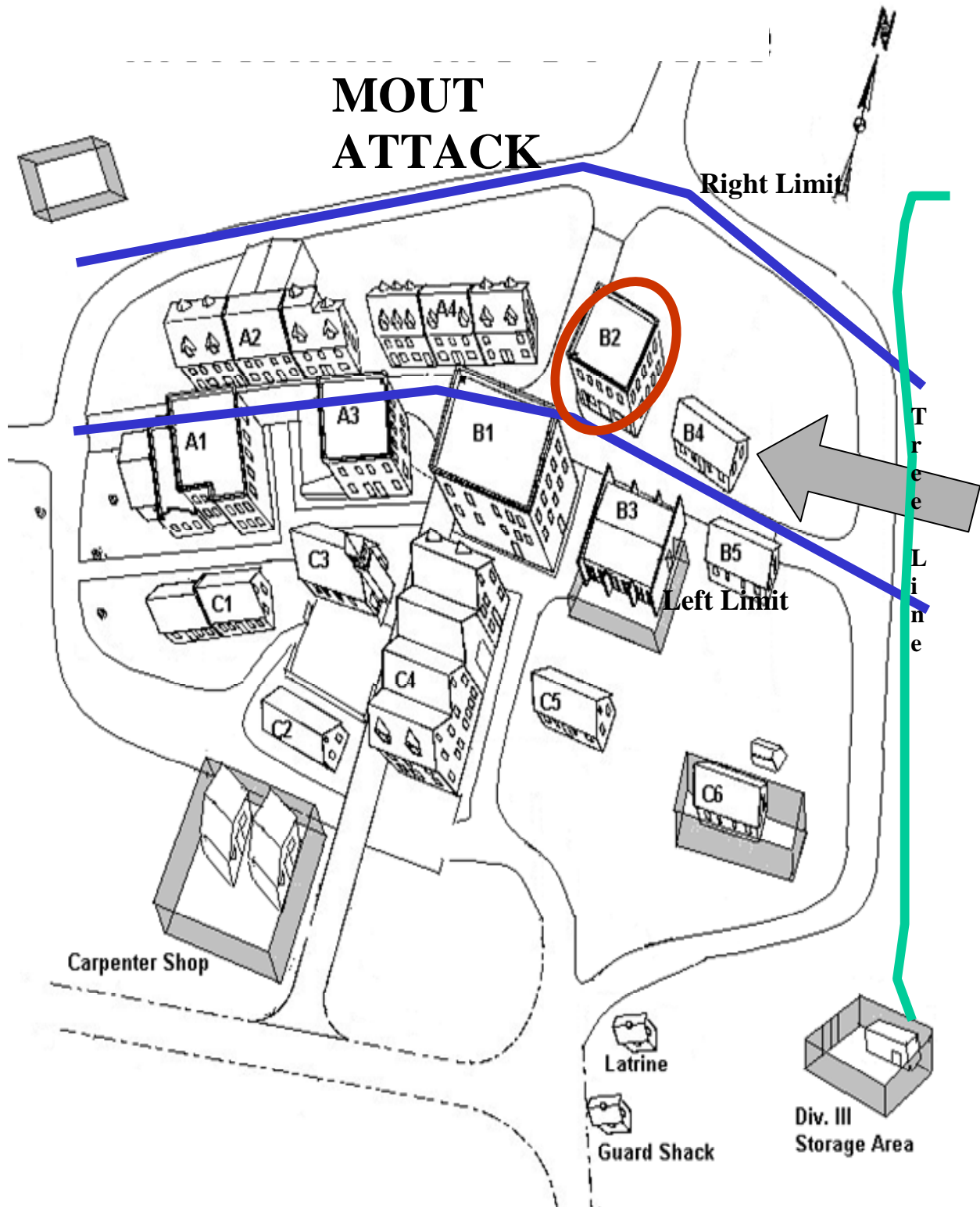


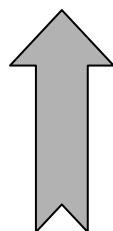
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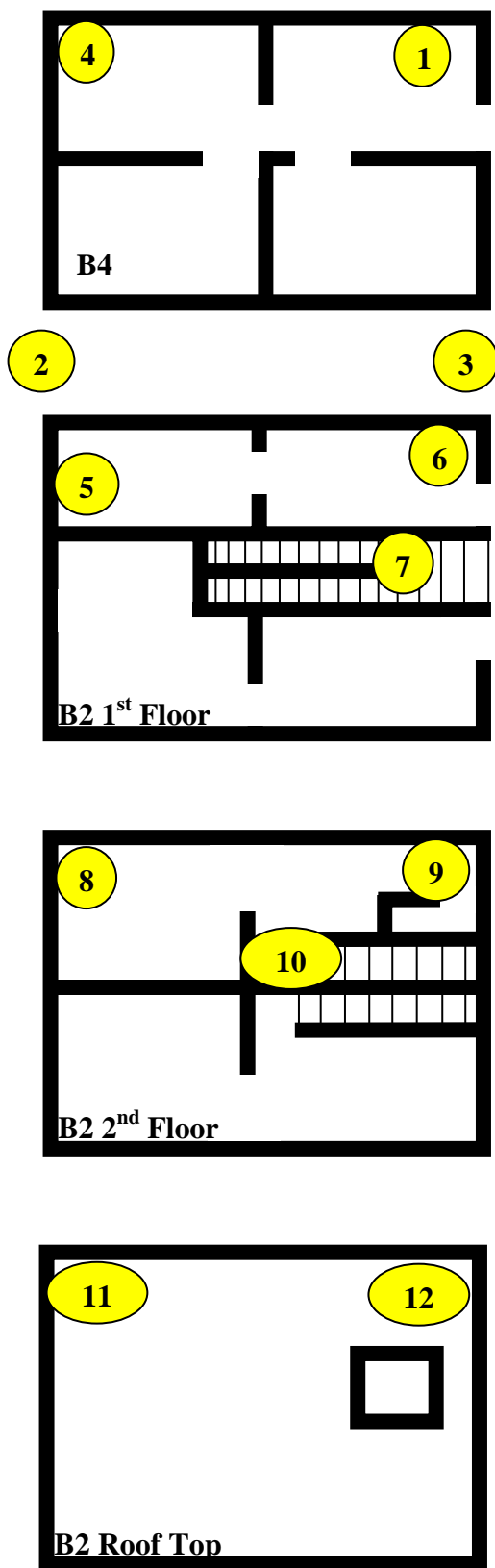
## Appendix D. MOUT Attack and Defend Mission Layout

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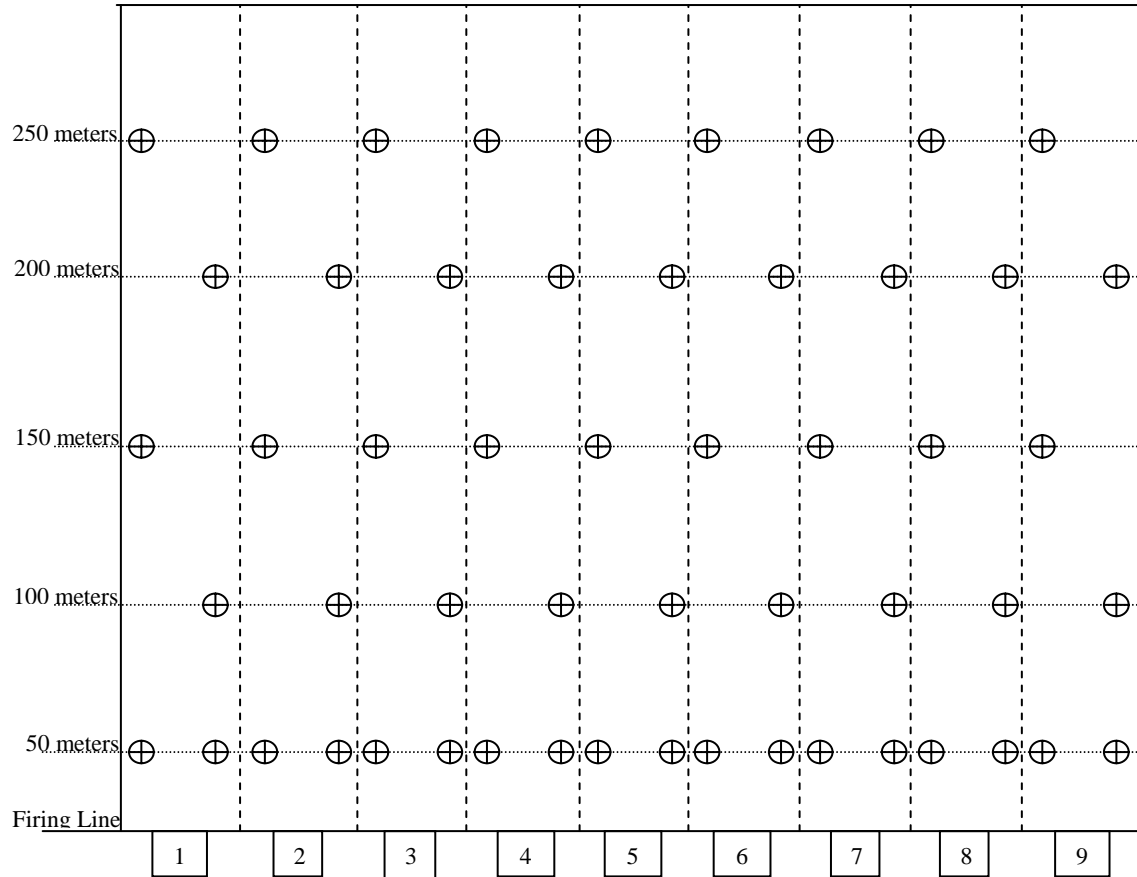




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## Appendix E. Night Qualification Range

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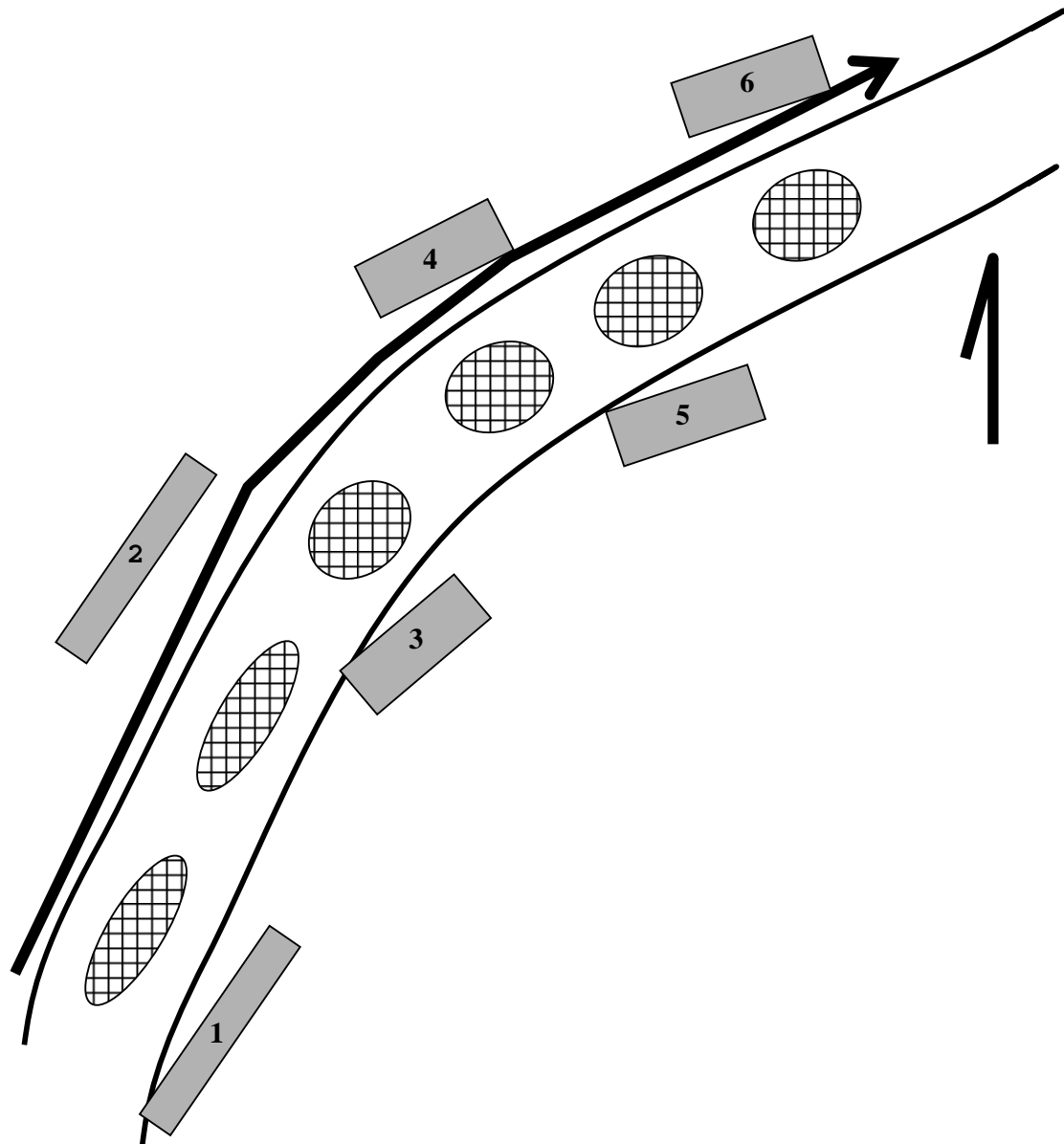


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## Appendix F. Hasty Ambush Layout

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## Appendix G. Human Factors Engineering Questionnaire Results

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### SOLDIER DEMOGRAPHICS

SAMPLE SIZE = 68

<u>TIME IN SERVICE</u>	<u>MOS</u>	<u>AGE</u>	<u>RANK</u>
37 months (mean)	11B – 67 11M - 1	22.5 (mean)	E-1 - 2 E-2 - 7 E-3 – 18 E-4 – 28 E-5 - 9 E-6 - 4

### DUTY POSITION

Team leader	19	M203 Gunner	6
Automatic Rifleman	1	OPFOR	8
Antiarmor	1	Platoon Sergeant	1
Bradley driver	2	Rifleman	10
Grenadier	5	Saw gunner	8
Gunner	2	Squad leader	4
Infantry	1		

1. What is your height? 70.2 inches (range is 65 to 76)
2. What is your weight? 176 pounds (range is 137 to 261)
3. With which hand do you most often write? 63 right 4 left 1 NR
4. With which hand do you most often fire a weapon? 59 right 9 left
5. Have you ever used a thermal device or weapon sight?

38 Yes 30 No

25mm gun, Javelin CLU, ACOG, AN/TVS-5, Bradley ISU, Bradley thermal sights, CCO, Dragon Night sight, PVS-13, M-68, PAS-13, TOW Thermals, Tow missile system .

6. Have you ever used a night vision device?

59 Yes 6 No 3 NR

PVS-4, PVS-5, PVS-7, PVS-14 , Bradley drivers night sight, PAQ-4, VVS-2, Javelin

7. Do you smoke? 30 Yes 38 No

8. What was your last M4 qualification rating?

46 expert 12 sharpshooter 9 marksman 1 NR

9. Do you wear prescription lenses? 22 Yes 45 No 1 NR

a. If yes, which do you most often wear? 9 glasses 14 contacts

b. Which do you wear while firing a weapon? 11 glasses 12 contacts

c. Which is your dominant eye? 10 left 48 right 8 unsure

10. Have you ever used a GPS?

54 Yes 14 No

11. How often do you do each of the following computer activities?

	<u>Never</u>	<u>Sometimes</u>	<u>Often</u>	<u>NR</u>
Games	6	39	21	2
Word processing	21	38	6	3
Spreadsheets	43	20	2	3
Graphics	40	24	1	3
Internet	2	20	44	2
Programming	49	16	0	3

AN/PSN-11, E-Trek, GARMIN, MAGELLAN, Military issue, PLGR, RINO 120

12. Have you ever used military software?

16 Yes 49 No 3 NR

Form Flow, Power Point

13. Please rate your skill level for each of the following activities:

	<b>terrible</b>	<b>very poor</b>	<b>poor</b>	<b>neutral</b>	<b>good</b>	<b>very good</b>	<b>expert</b>
Map reading				14	26	18	9
Land navigation			4	15	25	16	7
Computer use	2	2	4	15	25	18	1
GPS use	3	3	6	20	19	13	2

## TRAINING

SAMPLE SIZE = 65

Please rate the following using the scale below.

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
<b>Extremely bad</b>	<b>Very bad</b>	<b>Bad</b>	<b>Neutral</b>	<b>Good</b>	<b>Very good</b>	<b>Extremely good</b>

NIGHT VISION TOPICS:	MEAN RESPONSE	
	PVS14	ENVG
Focusing with visual acuity chart	4.63	5.50
Adjusting helmet mounts	4.60	5.38
Fundamentals of aided vision	4.56	5.76
Fundamentals of night movement techniques	4.49	5.42

### Comments

### No. of Responses

#### AN/PVS-14

Good and easy to use.	4
Lightweight.	6
Easy to focus.	1
They work well.	2
Focusing was easy; adjusting mounts easy.	1
Decent vision.	1
I like them because you can mount them on the weapon and they are much lighter on your head.	1
We use this night vision device in our unit. The movement through uneven terrain isn't bad. The 14's will be hard to top as far as basic night vision capabilities are concerned.	1
It is ok for seeing at night but I could not see a person hiding in bushes or not moving.	1
Nods move around too much.	1
After a while seems to be very dim.	1
Adjustability of the mounts on the goggles is lacking.	1
I always have had problems with clarity using this particular model, especially when moving in the forest.	1
Need improvements and thermal.	1
Never worked with them.	2
Night vision capabilities cannot be adjusted to a great deal of detail. Also, have bad habit of becoming "fogged up".	1
No depth perception.	3
Ran into many problems.	1
The helmet mounts loosen over time and cause the goggles to rattle around on the mount. This causes the goggles to cut out on their power and makes focusing and adjusting a nightmare.	1
They do not have thermal vision.	1
They are kind of old and outdated.	1

## ENVG

Excellent. If they can be a little bit lighter then we are cooking.	1
Very similar to existing NVGs.	1
Can be adjusted to a great deal of detail; become very focused.	2
Good goggles. I like the way system works.	1
Good overall ergonomics. Everything is easily accessible. Very compact.	1
Easy to use.	6
I liked the B version very much.	1
Goggles were smaller and easy to operate.	1
Had lots of features; could see lots of detail. I could see very well in the dark.	1
Having the thermal aid is so much easier to detect the target and identify.	1
Very easy to mount.	1
I like the thermal and night vision and how they work together.	1
It was very informative.	1
Light weight and easy to use.	2
Excellent night vision.	2
Very good combination of thermal and easy to use.	1
State of the art equipment highly recommended for new generation.	1
The B goggles are a good set compared to the others.	1
Felt no difference from A goggles.	1
A manual way to initiate a calibration would be beneficial to this goggle. The elevation adjustment knob isn't strong enough to hold the goggles at elevation if they get bumped, the adjustment will move rather than hold because of the way it adjusts.	1
Adjusting helmets mounts is neutral because they did not have a mount for the modular integrated communications helmet (MICH).	1
Didn't waste time with stuff we already knew.	1
I don't like the fact that I cannot adjust from right eye to left eye. I have to take the item off.	1
I thought the night observation devices (NODs) were too elaborate because of the technology involved with it, but I was very pleased with the new creation.	1
Power cable will be a problem. Will get snagged and broken easily.	1
These goggles didn't seem to focus as good as older models.	1
They are kind of heavy and hurt my neck.	1
Too many buttons on adjusting mount. Some of the buttons seemed fragile. Use under combat conditions could cause breakage.	1
We didn't move around with the goggles on.	1

TRAINING FEATURES:	MEAN RESPONSE	
	PVS14	ENVG
Operating procedures	5.19	5.57
Donning & doffing procedures	5.02	5.34
Level of detail presented	4.97	5.74
Adequacy of training aids	5.19	5.66
Adequacy of training materials	5.27	5.65
Length of training session	5.38	5.52
Overall rating of training	5.54	5.90



**Comments****No. of Responses****AN/PVS-14**

No comments.

**ENVG**

Very simple and easy to use.	6
The equipment was simple and easy to assemble. It is very difficult to confuse anything, which is good under stress.	1
Easy for new Soldiers and old Soldiers to learn quickly.	1
The presentation of this goggle was very knowledgeable. This goggle was very easy to understand.	1
Good goggles.	2
Good instruction that was kept short and simple.	7
Very interactive training. Vendors were very informative and helpful.	1
Training was detailed and covered all aspects.	1
Good training feature.	1
Lightweight even with the added thermal.	1
Very nice with the night vision/thermal auto adjust capabilities. Very lightweight, don't know if its very durable. Will soon find out.	1
Operating was straightforward.	1
Outstanding equipment; a must have accessory.	1
Please let us field-test them now!! The NVG's of the future!	1
The features on the ENVG are basic and simple. There is not much to be messing around with.	1
These are simple and self-explanatory to use. These are great for the field.	1
They are slightly better than the A goggles.	1
The NODs were very simple to work, but the one thing that I didn't care for was the battery box.	1
Simple to use but still a little heavy.	1
Training time was a little long and drawn out.	1
Thermal is great, but needs to weigh less.	1
Too heavy and too complicated.	1
I feel that there might be to many buttons to operate the goggles in a speedy manor during an assaulting maneuver.	1
I had some trouble in adjusting the lenses to the left or right in order to have optimum vision. It was not the worst though.	1

# WOODLAND IMT

SAMPLE SIZE = 52

1. Please rate the following using the scale below.

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
<b>Extremely bad</b>	<b>Very bad</b>	<b>Bad</b>	<b>Neutral</b>	<b>Good</b>	<b>Very good</b>	<b>Extremely good</b>

GOGGLE CONTROLS:	MEAN RESPONSE	
	PVS14	ENVG
Ease of understanding control function	5.86	5.71
Location of controls	5.88	5.51
Access to controls	5.86	5.61
Ease of activating controls	5.86	5.74
Ease of adjusting mix of thermal & I <sup>2</sup>	NA	5.33
Control settings were maintained during the trial	5.82	5.00

## Comments

## No. of Responses

### AN/PVS-14

Always been good to me.	1
Easy and simple controls.	5
These are superb, time proven goggles. Everyone in the army loves these things, and even without thermal capabilities, we Soldiers would prefer these to the B goggles.	1
Like the fact that the batteries are emplaced into the goggle system itself; you don't have to worry about the battery getting hung up on anything.	1
The goggles maintained a steady position throughout.	1
Very well maintained sight picture.	1
Nothing bad happened while in use.	1
No real problems with controls; this goggle is familiar though.	1
Keep the 14's.	1
Until the last point they stayed on. At the last point they shut off for a few seconds and I had to reset.	1
No thermal.	1

### ENVG

Easy to use.	3
I didn't have to worry about settings.	1
The knob system is far better. The knobs are simple and quick, user friendly, and easy to get the right amount of thermal.	1
Goggles faired very well for me on this test I did have and adjusting or power outages at all.	1

Goggles would focus anywhere outside the thermal square. 1  
 Worked pretty well all around. 3  
 Mixing I<sup>2</sup> and thermal and getting a good mix is difficult at times. 1  
 Thermals did not work very well. 5  
 I<sup>2</sup> did not work very well. 1  
 Control settings were maintained but the goggle itself was very bad. It would fog up or get blurry even if I tried to focus it afterward. 1  
 Goggles turned off while moving. 2  
 Had to keep adjusting them while moving. 1  
 Settings bumped around. 1  
 Thermal went to calibration and stayed on calibration right before reaching first target detection point, had to manually power down thermal to reset, took approximately 30 seconds. 1  
 When I got up and down I would wait for it to focus. 1  
 When I un-slung my weapon the battery case popped open and all of my batteries spilled out. I was unable to laze the last target. 1

GOGGLE MOUNTING:	MEAN RESPONSE	
	PVS14	ENVG
Ease of attaching mount to helmet	5.96	5.69
Ease of attaching goggle to helmet mount	5.90	5.69
Stability of helmet mount	5.33	5.31
Balance of goggle on helmet	5.31	5.20
Wearing comfort	5.43	5.10

## AN/PVS-14

Light and compact. 1  
 They stayed on the helmet well. 1  
 They were very comfortable and balanced. 1  
 They wiggle sometimes, but they are pretty comfortable. 1  
 This goggle is very user friendly. 1  
 A little shaky but that is a common problem with all 14's. 1  
 Mount kept slipping or coming off. 4  
 Could not get goggles to adjust the way I wanted it to. 1  
 Goggles swing function loose, had to readjust (by hand, not knobs). 1  
 Helmet mount (swing arm) is never tight enough. 1  
 Kept getting hung up during low crawl. 1  
 The straps have to go. 1  
 With a simple turn of a screw in to the Kevlar<sup>4</sup>, the mounting system is one step short of flawless; the vertical axis is a little wobbly. 1

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<sup>4</sup>Kevlar is a registered trademark of E.I. DuPont de Nemours & Co., Inc.

Not balanced. 1  
Wearing not to good little heavy but will work. 1

## ENVG

Very good configuration with mounting system 1  
Good. 1  
Comfortable and pretty stable. 1  
The Kevlar mount relationship with the flip mount is very solid and very sturdy. 1  
They didn't move while I was moving and they were very stable. 1  
No major problems with mounting. 1  
Putting it on is not hard. 1  
They are very uncomfortable. 1  
Balance on the helmet is good except when running. 1  
Cannot adjust goggle close enough to my eye. 1  
Goggles kept falling. 1  
Goggles were too wobbly. 2  
Heavy in front. 3  
Very uncomfortable. 1  
Mount fell off during course. 1  
My straps came lose. 1  
Weight became a factor when I was low crawling. 1  
I think the goggle to helmet mount is a little sensitive. It feels like if you were to have to 1  
put it on in a hurry, or in a Bradley that is moving it might break it.  
My only complaint was the vertical axis adjuster; which came loose throughout the 1  
course and had to be manually pushed back into place.

2. Please rate the following characteristics using the scale below.

1 2 3 4 5 6 7  
Extremely Very bad Bad Neutral Good Very good Extremely  
bad good

CHARACTERISTICS:	MEAN RESPONSE	
	PVS14	ENVG
Weight of goggle	5.38	5.02
Shape of goggle	5.68	5.27
Adequacy of field of view	5.50	5.02
Ability to perceive depth	5.10	5.04
Sight picture brightness	5.50	5.22
Sight picture clarity	5.40	5.02
Color of thermal overlay	NA	4.88
Ease of eyepiece adjustment	5.74	5.29
Ease of stowing goggle in flip-up position	5.98	5.86
Once stowed, goggle maintains flip-up position	6.02	5.90
Overall ease of use	5.78	5.34

## **AN/PVS-14**

This is a very good goggle.	2
No complaints.	1
Never had to adjust.	1
It is surprising how well the goggles perform.	1
Great clarity with moon and starlight. NVG's were very easy to adjust and focus, and they offered a bright, clear picture.	1
Good weight, easy to stow.	1
Stayed in place the whole time.	1
It's small, crystal clear, and bright, with virtually no weight and it is very stable on the Kevlar. Depth perception is decent.	1
The clarity was good other than identifying targets behind grass.	1
No thermal but still accurate and light.	1
Field of view leaves a little to be desired.	1
A little foggy and depth perception was off.	1
A little blurry.	1
Depth perception could be better.	2
Goggle lens cup rotated during movement.	1
Had to stop and turn knob on bottom during course was kind of difficult.	1
If only the 14's had a brightness control knob.	1
The sight picture had little white dots all over.	1

## **ENVG**

Good goggles.	3
Not as good as the PVS-14. The thermal was also very good in this case.	1
The sight picture was great and the clarity was good.	2
Thermal was great.	1
Saw orange outline with thermals off/low.	2
The coating on the lenses leaves something to be desired.	1
Unstable.	1
Control settings changed while moving from one obstacle to the other.	1
Sight picture could be sharper/clearer.	6
Got caught on wire while low crawling, thermal overpowered everything else when it stopped functioning correctly.	1
Had problem with the thermal staying in calibration mode.	1
It's hard to adjust the diopter focus without moving the eyecup.	1
It would be nice if it was a bit lighter, cause it may look and feel light the first time you put it on but it sure don't feel like that after a while.	1
Overlay still a little much.	1
The battery pack fell off while I was low crawling.	1
Goggles did not stay fixed in same position.	2
Thermal overlay interfered with I <sup>2</sup> picture; box leaves residual corners on display; goggle hit weapon a couple times during high crawl; and I <sup>2</sup> brightness too easy to inadvertently change while adjusting objective lens.	1
Thermals will not function if you're moving your head fast.	1
This goggle would fog up or get a blurry picture. Would not focus.	1

When in the flip up position it stows way too high. For the mechanized infantry this 1  
would not work at all.

3. How good was your situational awareness -- your knowledge of what was going on around you -- during this trial?

1 2 3 4 5 6 7  
Extremely Very bad Bad Neutral Good Very good Extremely  
bad good

MEAN RESPONSE	
PVS14	ENVG
5.71	5.35

#### AN/PVS-14

Good goggles overall. 1  
I<sup>2</sup> vision good with these goggles. 1  
I was aware of my surroundings. 1  
My focus was very good getting up and down from the prone. 1  
Running these obstacles was easy other than trying to stay in your lanes. 1  
There were only a few times I couldn't really see what was there. 1  
Hard to see through fog. 1  
No peripheral or depth perception. 1

#### ENVG

It was good mainly because of the thermal. 2  
Good field view. 1  
Good run. 1  
It was all right. 1  
I knew where I was the entire time. 1  
I could see almost everything. 1  
None. 1  
I could not get a very good thermal I-squared picture at all or by themselves. 1  
Situational awareness was down because of loss of focus. 1  
The screen is little narrow. 1  
Thermal calibration problem prevented optimal situational awareness. 1

4. What is your overall rating for the goggle you used for this trial?

1 2 3 4 5 6 7  
Extremely Very bad Bad Neutral Good Very good Extremely  
bad good

MEAN RESPONSE	
PVS14	ENVG
5.52	5.22

#### AN/PVS-14

Everything was all right.	1
Good goggles.	1
Its simplicity gives it a certain comfort.	1
Liked it.	1
I think it went great.	1
I think that if this goggle had a thermal image on it this would be the best goggle that anybody could make.	1
Not bad.	1
So far they are the best for this besides the fact that they don't have thermals.	1
No real problems with mounting or picture clarity/brightness.	1
Hard to see targets.	1
Minor problems with mounting system-having movement.	1

#### ENVG

Picture clarity good.	1
They were great during this exercise.	1
A very good piece of equipment! The knob system is outstanding in terms of getting the right I <sup>2</sup> /thermal ratio and the weight, shape and picture is outstanding as well.	1
Good goggles.	1
I believe it could have been better.	1
The mount needs a little work and the fogging issue can easily be resolved.	1
The picture of the goggle made me very unsure about this goggle.	1
The thermal/I <sup>2</sup> mix could use some work as well as moving the diopter focus without moving the eyepiece.	1
The thermals went out on me several times and always when I needed them most. It is most likely the mounting. Any running, or jolting it from the mounting would cut it off.	1
Thermal overlay went to calibration screen and stayed before target detection part of course, target detection took approximately 40-45 seconds due to fault. Goggle brushed weapon a few times during high crawl.	1
To heavy and I kept banging the battery pack while low crawling.	1

5. During this trial did you use mainly I-squared, mainly thermal, or an equal mix of the two?

1	2	3	4	5	6	7
100%	Mostly	Slightly I-	Equal Mix	Slightly	Mostly	100%
I-Squared	I-Squared	Squared		Thermal	Thermal	Thermal

MEAN RESPONSE	
PVS14	ENVG
NA	3.02

#### AN/PVS-14

Both work well.	1
Little fuzzy when finding targets.	1
No thermals.	1
That is all they are equipped with.	2

#### ENVG

Both work well.	1
You can identify your target with this very easily.	1
The I <sup>2</sup> mix was excellent and very clear.	3
Slight thermal was enough to detect targets.	1
I've yet to find a situation in which to use a higher thermal mix.	1
If it had thermal, I might have used it.	1
I like more I <sup>2</sup> and just being able to see thermal.	1
Adjustment was much more difficult this time due to use of gloves for IMT course.	1
Could not immediately identify thermal targets so I bumped it up slightly.	1
There are 2 lines across the viewing screen. One on the top and one on the bottom. I noticed if you look up with the goggles the picture turns orange if you look down with the goggles the picture turns green.	1
Thermals didn't work.	3
To the best of my ability and the best I could.	1
Wasn't really paying attention.	1

6. Did you experience any problems using the goggle during this trial? Check all that apply.

No. of Responses		
	PVS14	ENVG
Eye strain	5	11
Tunnel vision	3	4
Headaches	2	4
Motion sickness	2	2
Nausea	2	2
Disorientation	2	2
Dizziness	2	2
Lens fogging	12	12
Screen white-out	0	0



7. Did you experience any other problems with the goggles?

#### AN/PVS-14

No problems.	2
Bad lens fogging.	1
Lens just kept fogging up.	1
The goggles were too bright.	1

#### ENVG

No problems.	3
My goggles cut off on me during the low crawl.	1
No thermals.	1

8. Using the scale below, rate your ability to perform the following tasks during the trial.

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
<b>Extremely hard</b>	<b>Very hard</b>	<b>Hard</b>	<b>Neutral</b>	<b>Easy</b>	<b>Very easy</b>	<b>Extremely easy</b>

TASKS:	MEAN RESPONSE	
	PVS14	ENVG
Crawl through pipe	5.55	5.52
Negotiate zigzag course	5.69	5.58
Jump over obstacle	5.53	5.06
Run up mound	5.67	5.44
Run down mound	5.58	5.35
Get into foxhole	4.27	3.54
Assume foxhole supported position	3.71	3.54
Get out of foxhole	3.71	3.54
Low crawl	4.96	4.86
Move at a quick steady pace	5.61	5.34
Perform combat rolls	5.53	5.44
Assume prone firing position	5.51	5.52
High crawl	5.61	5.22
Assume kneeling firing position	5.92	5.80
Scale high wall	5.78	5.48

#### AN/PVS-14

All tasks where pretty good.	1
I felt very comfortable with these goggles in tonight's conditions.	1
This goggle gave me a very good sight picture and was very accurate on its depth perception.	1
It was pretty easy.	1
I like it.	1
If these had thermal then these would be the best.	1
It was fairly easy to complete, but could have been easier.	1
Had problems during low crawl.	3

After the low crawl it messed up the position and I had to hold them up with my hand.	1
I couldn't see the drop off on the downhill.	1
Minor problems with depth perception on jumping obstacles.	1
NVG's came off on low crawl.	1
Prone position is always difficult with goggles on.	1
The depth perception was hard to accrue coming down the mound.	1
The only problem I had was fogging in the lens.	1

## ENVG

All together it functioned good.	1
The course was smoother with these than the others.	2
At the high wall my batteries case opened.	1
Battery box got caught and dislodged in low crawl area. Operator fault not equipment.	1
Depth perception was a little off.	1
Everything was easy except that the goggles kept pulling my helmet down. I didn't try to jump the obstacle because I didn't want to fall.	1
Goggles hit weapon while performing high crawl, depth perception provided problems for the low jump, running up the mound, and scaling the high wall.	1
I had to do all this without the thermals, but with the I <sup>2</sup> it was pretty good.	1
Goggles got unbalance after I was running for a while.	3
Prone was the only difficult position to see through the goggles.	1
The first jumping up obstacle came to a surprise.	1
Thermal with out after jumping down from high wall.	1
This pair of goggles were very scary they had a horrible I <sup>2</sup> -thermal mix and I could not see at all were I was going.	1
Would have to focus the goggle when getting in and out of the prone.	1

## MOUT TARGET DETECTION

SAMPLE SIZE = 72

1. Please rate the following using the scale below.

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
<b>Extremely bad</b>	<b>Very bad</b>	<b>Bad</b>	<b>Neutral</b>	<b>Good</b>	<b>Very good</b>	<b>Extremely good</b>

GOGGLE CONTROLS:	MEAN RESPONSE	
	PVS14	ENVG
Ease of understanding control function	6.13	5.93
Location of controls	5.86	5.67
Access to controls	5.83	5.71
Ease of activating controls	5.85	5.85
Ease of adjusting mix of thermal & I <sup>2</sup>	NA	5.71
Control settings were maintained during the trial	5.90	5.51

### Comments

### No. of Responses

#### AN/PVS-14

Still top picture for night vision.	1
Best I have ever used.	1
Control settings were good.	1
Controls are easy to use; adjust.	9
It was easy to find and manipulate the controls and the setting stayed the same during the exercise.	1
The knobs make it easy to use.	1
Good goggles.	5
Very useful for missions.	1
Focus parts could be a little clearer, but very good.	1
If we could keep these and just add the thermal that would be superb.	1
Great control operation.	1
You can't teach an old dog new tricks. These have the good old feel to them, as well as the assurance they have been battle tested. They are simple and very user friendly.	1
Very familiar with these goggles.	7
They aren't that bad when brand new.	1
Controls a little hard to get to. Like the IR flash.	3
The brightness adjustment was a little hard to use.	1
Controls don't work good in the prone, as far as up and down.	2
Dimmer switch could be more accessible.	1
No thermal.	7
This model is basic; it needs the thermal. It was hard to ID some targets in dark windows or doors.	1
Had to adjust due to bounce during movement.	1
Fogging due to higher heat and humidity.	4

Muscle memory is the only reason these questions are answered as they are.	1
The vision got blurry the farther into the test course.	2
A lot of the targets were impossible to see without the IR flood from the PEQ-2 laser.	1
Depth perception is difficult to near impossible.	1

## ENVG

Excellent goggles.	8
I found that if I use total brightness and half thermal, I can see outstandingly.	1
Should be integrated as soon as possible (ASAP).	1
Best goggles I've used so far.	1
Kept picture quality throughout the whole run.	1
Was able to identify targets fast and in great detail.	3
Easy to use and adjust.	6
We only used them for about an hour this morning and I already feel comfortable with operating them.	1
The controls on the B were well placed and easy to adjust. They are simplified which is good for Soldiers under stress and sleep deprivation.	1
Knobs are VERY easy to use and get to.	2
User-friendly format. There was no challenge in making on-the-spot adjustments.	1
The mix of thermal and I <sup>2</sup> was great for target acquisition.	2
I like how you control the ratio of thermal to I <sup>2</sup> .	1
Controls were simple and easy to use.	11
Controls were easily accessible.	3
You didn't have to remove both hands from weapon.	1
Controls stayed on settings.	5
Everything was well placed and didn't change anything from the past.	1
Like the default function to find the middle ground.	1
The goggles stayed where I put them without moving like the alphas.	1
At some angles, the thermal would just disappear and it would be only I <sup>2</sup> ; and at one point my I <sup>2</sup> shut off and the screen went bright orange and I couldn't see any thing.	1
Hit battery pack and it cut out.	1
I'm just not used to the controls yet.	2
Locating the controls was kind of hard.	1
It seemed like I had to keep adjusting the settings.	1
If you bump the knobs, you will knock off the setting you have it on.	2
The thermals kept resetting themselves in the middle of the trial.	1
When trying to adjust IR, it's too easy to switch to full thermal and vice versa.	1
Thermals were sensitive to movement up and down.	1
The thermal knob seemed loose and adjusted on its own.	1
It was hard to ID targets when you had both I <sup>2</sup> and thermal on.	1
The thermal would fade in and out.	1
I <sup>2</sup> was too dim to see far targets.	1
Should focus automatically.	1
I <sup>2</sup> needs more focal adjustment.	1
When eyecup is folded back it, it gets in way of thermal adjustment.	1
The I <sup>2</sup> needs to be more sensitive.	1
The main problem that I had was getting the right setting for target ID.	1

Thermal I<sup>2</sup> should have a default setting to get maximum target identification. 1  
 There are a lot of functions on this system that makes it a little difficult to get used to. 1  
 Thermal cut out twice and had to wait for calibration. 1  
 Would like to see the controls be able to be on either side so that if you fire left handed 1  
 you don't have to take your hand off the trigger to use the controls.  
 Needs auto shut off when flipped up. 1  
 Thermal seemed to brighten and dim throughout exercise. Possibly because the 1  
 batteries were dead.  
 They were a little heavy after a while and mostly in the prone. 1

GOGGLE MOUNTING:	MEAN RESPONSE	
	PVS14	ENVG
Ease of attaching mount to helmet	5.79	5.65
Ease of attaching goggle to helmet mount	5.81	5.72
Stability of helmet mount	5.08	5.55
Balance of goggle on helmet	4.67	5.40
Wearing comfort	4.72	5.25

#### AN/PVS-14

Lightweight, stable, excellent. 5  
 These were so well balanced that I didn't really feel the weight. 1  
 Easy to mount. 6  
 Easy to adjust. 1  
 Very comfortable. 1  
 Wear was good, and the assembly of NVGs to Kevlar was easy. 1  
 Works very well with the Mitch helmet. 1  
 Every pair of 14's I ever used always have a slight wiggle in them, but it doesn't really 1  
 impair use just makes a lot of rattles.  
 Unstable. 6  
 Back part of mount felt like it was digging into back of head. 1  
 Bouncing during movement (running) affected by mount/goggles. 2  
 Goggles are wobbly. 7  
 Mounting loosened after 3 IMT's. 1  
 The goggles themselves were a little loose in the joints and would sometimes move. 1  
 The mounts always end up loosening with service life, which leads to the NOD shorting 1  
 out because of the magnetic field being cut.  
 Very front heavy. 6  
 Needs more positioning knobs. 1  
 The small knobs are just not working. Attaching the NOD to the mount is just a pain in 1  
 the rear and in a combat situation a quick dismounting and mounting might be best.  
 The screw knob is just not working.  
 Pushed my Kevlar down in front slightly on a couple of occasions but not bad. 1  
 The strap on the Kevlar has to go. The screw base is easier for NVG installation in the 1  
 long run, as well as giving the NVG's a more secure feel. The swing arm itself gets a  
 little loose.  
 Fog up a lot easier. 1  
 Goggle has a tendency to fall down when you tighten it for either eye. 1

Tilt needs to be more accessible on the move or in the prone. 1

## ENVG

The Bravos are better than the Alpha's without question. 1

Excellent. 3

Goggles stayed on K-pot good. 1

Very comfortable. 1

Nice balance of weight, stable. 2

The goggles balanced much better than older models. 1

Lightweight so it did not pull my helmet down. 1

It was light in comparison to the overall weight of the system with the Kevlar. It had a little movement when moving at a high rate of speed but all in all, it was good.

Easy to mount. 2

Mount was very sturdy didn't have any problems with it moving around or having to readjust my point of view to see through it. 2

NODs are never going to be very comfortable things, but these are all right. 1

Stayed in good position while in the prone. 1

The goggles are very comfortable compared to other night vision that I've used before. 1

The flip mount and the adjustments are easy and simple. 1

Works well with the Mitch helmet. 1

If they cut off for whatever reason, your adjustment would be off. 1

If they could be adjusted more it would make them even better. Hard to see in the prone. 1

Little heavy; could be a little lighter. 3

It felt a little heavy in the front. 5

It was heavy and kept pulling my helmet down over my eyes. 3

The weight of the goggles made me drop down my helmet, so I had to move it few times. Maybe if you balance the weight with more batteries it will prevent this. 1

Mount adjustment knobs need to be more defined. 1

Need to have a permanent mount that attaches to helmet. 1

Needs to be a little more stable. 1

Mounting system takes some fiddling with when first mounting. 2

The straps are very unstable, so a possibility to screw the base to the Kevlar is wanted. 1

The only problem I had was the strap that sucked the goggles down caught the wall when I climbed under it and released causing the goggles to come off. 1

To change eye placement you need to remove the ENVGs and change it. Unlike the 14's when it was one easy movement. 1

Would shake and does not fit to the eye as needed. 1

Attachment similar to PVS-14, so familiarity helped. 2

I wish all the goggles could be configured in more of a halo so you could distribute the weight better. But I am not a scientist so I don't know if that would work. 1

It is kind of hard to adjust and mount the goggles in the dark. 1

You're suppose to line up the red dot to attach the power cable, what about when it's dark out? Needs to be something you can do by touch and memory. 1

Battery cord is a little awkward. 1

2. Please rate the following characteristics using the scale below.

1	2	3	4	5	6	7
Extremely bad	Very bad	Bad	Neutral	Good	Very good	Extremely good

CHARACTERISICS:	MEAN RESPONSE	
	PVS14	ENVG
Weight of goggle	5.13	4.99
Shape of goggle	5.56	5.39
Adequacy of field of view	5.00	5.26
Ability to perceive depth	4.36	5.38
Sight picture brightness	5.21	5.58
Sight picture clarity	5.15	5.38
Color of thermal overlay	NA	5.45
Ease of eyepiece adjustment	5.32	5.43
Ease of stowing goggle in flip-up position	5.69	5.76
Once stowed, goggle maintains flip-up position	6.07	6.24
Overall ease of use	5.54	5.73

# AN/PVS-14

A nice bright and crisp picture.	4
PVS 14's are a classic and built to perfection.	1
They are light and small.	1
Easily manageable.	1
Good goggle.	3
Easy to use, simple.	5
It has good characteristics.	1
I've been trained with these and know the controls well.	2
Very good, very little movement while running.	1
Depth perception is not very good.	4
Distance was a problem.	1
Dull snowy picture.	1
Difficult sometimes in the prone.	1
Prone position caused some difficulty because of tilt.	1
Goggle didn't turn off when in the up position.	1
The picture clarity wasn't good and I couldn't silhouette enemy personnel.	3
Had trouble identifying targets in dark rooms.	1
Identifying target outlines in a window/door was difficult.	3
I couldn't see the targets.	2
The lens fogged up.	2
I did not like these at all.	1
I didn't know I could use my IR flood until about half way through the lane.	1
I think that it's probably a problem with ballistic helmets, but once on your face it lost its sight and would slide out of place easily.	1
If I did not lose focus everything probably would have went okay.	1
They sometimes fall back down from the stowed position.	1

The weight of the goggles slid my K-pot down over my eyes a little bit.	1
This model a little more face friendly with thermal and better weight distribution would be ideal.	1
Weight it too forward and not balanced.	1
The absence of thermal capability was definitely a minus.	2

## ENVG

I think these goggles are the best.	1
Good.	2
Easy to distinguish targets.	2
Everything works well with these goggles.	1
Depth perception and picture clarity unlike anything I've been able to achieve with issue goggles. Outstanding really.	4
Doesn't take a lot of time to get it mounted and ready for the mission.	1
I can see with these.	1
It was great with stowing procedures, when flipped up. You didn't have to worry about it falling down.	1
The thermal overlay was great; it was easy with the shape of the targets.	1
Very simple to use.	2
Great because its one less thing you have to think of when you're trying to fight a battle.	1
Very lightweight, didn't weigh my Kevlar down in the front, didn't cause any neck pain.	2
I think the mount on the B model is a lot better than the old one. It's easier to adjust the goggles to your face.	1
You can also turn the brightness down a lot more.	1
They were pretty effective.	1
Very well balanced and sight picture is better than any I've seen.	1
Thermal picture was very good, made identifying targets easy.	1
A little blurriness while on the move.	2
Color of overlay square on the thermal was in the way for night vision viewing.	1
The thermal overlay was either bright or dark. I had to constantly change the controls.	1
For me it was either thermal or I <sup>2</sup> , there was almost no in-between.	
Thermal overlay was a little distracting; it was a little difficult to walk with that orange square in my face.	1
When I would walk I would have to stop to see thermal in overlay at a distance but up close it was easy.	1
Did not like that when the goggle was hit too hard the thermals would reset.	1
Once in the prone, was hard to adjust to look forward. Felt awkward.	1
Fogged up a little bit at the end.	3
Goggle didn't turn off in upright position.	1
In a shadowed area the E silhouette targets were slightly difficult to make out clear until I used the PEQ-2 flood light.	1
Power supply wire has potential to snag on debris. Wires protruding through mount may get cut in field usage.	1
Seems like a small field of view.	1
Sight brightness is too dim. Clarity is not really good. You could barely identify targets.	3
Needs more focal adjustment for clarity.	1



You cannot adjust focus out far enough. They need to be able to be turned off when flipped up.	1
The only problem I had was identifying non-thermal targets.	1
The outline of the thermal box is brighter making me have several false ID's.	1
They would not stay on if they were moved up even just a little.	1
Two sight goggles would be more comfortable for the eye.	1
"Ghost effect" threw me off a bit.	1
The thermals seemed too dim sometimes but that might have been my glasses	1
Depth perception is a little off, it seems like you're looking thru somewhat of a wide-angle lens.	1
It still is kind of heavy and starts to hurt your neck after awhile.	2
Seemed to sit high when stowed.	1
I wouldn't want to walk with this all night.	1
Thermal field of view should be greater.	1
When adjusting eyecup, involuntarily adjust rear sight mechanism due to eyecup being too tight.	1
When moving into building lost all depth perception. While running with the thermal up more than the night vision the thermal went blurry and was hard to move around.	1
Wish it had the sleep mode when stowed.	1

1	2	3	4	5	6	7
Extremely bad	Very bad	Bad	Neutral	Good	Very good	Extremely good

# AN/PVS-14

Needs improvements. 1  
 Target acquisition was difficult at some of the stations. 1  
 No thermals and if illum is bad, no good picture is available. 1  
 Sight with NVGs is bad. 1  
 The NODs have a few kinks that need to be fixed. 1  
 Windows were real dark and I was under the impression that there would be at least 2-3 targets per station. If I went through the lane again with same NODs knowing what I know now, I would do much better. 1  
 Balance on helmet needs to be equalized so all weight isn't in front. 1

## ENVG

Excellent. 1  
 I was able to see everything around me. I had no problem with trying to adjust to see buildings and structures. 3  
 Good training with these goggles. 1  
 Easy to access controls. 1  
 Easy to use. 1  
 I could move at a high rate of speed and could see the objective that I was going to and still detect my target quickly. 1  
 Could find targets with ease. 1  
 Very clear I<sup>2</sup> and could see through the thermal square and the only time I saw thermal was when it was present in a target. Otherwise the I<sup>2</sup> made things very easy to maneuver. 1  
 The peripheral vision is pretty much non-existent, but the overall brightness makes up for it. At least you're able to see where you're going even though you may have no depth perception. 1  
 These goggles were little bit heavier but they were good. 1  
 Good awareness when standing still, but when running it was hard to tell what was around me. 1  
 Depth perception was good, but thermal field of view should be greater. 1  
 Field of view limitation inherent in all NODs. 1  
 Situational awareness was compromised, I felt, due to the clarity problem of my sight picture. 1  
 First time thru obstacle so I was trying to see where I was going. 1  
 I had few problems for little amounts of time. 1  
 I had to keep adjusting to see what was out there. 1  
 It fogged up a little. 1  
 It was hard to see in the prone. 1

4. What is your overall rating for the goggle you used for this trial?

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
<b>Extremely bad</b>	<b>Very bad</b>	<b>Bad</b>	<b>Neutral</b>	<b>Good</b>	<b>Very good</b>	<b>Extremely good</b>

MEAN RESPONSE	
PVS14	ENVG
5.06	5.79

## **AN/PVS-14**

Outstanding.	1
Easy to use.	3
Good goggles.	3
Good size.	2
Clear picture.	1
I love the weight.	1
They do not make me dizzy or strain my eyes.	1
Not too bad.	1
Comfortable with this system because this is what we currently use.	3
It was nice to have just I <sup>2</sup> cause I wasn't trying to over concentrate on thermal.	1
Decent but not something that I would look forward to or encourage the use of.	1
Although I had a lot of difficulty identifying human targets in some of the rooms, I can see how thermal would be useful for that.	1
A good piece of equipment but needs lots of improvements.	2
Fogging.	4
Stability and to a lesser extent target acquisition were my biggest problems with this goggle.	1
So-so weight.	1
Clarity was not good.	1
I think that if someone could just keep the system that this is but put thermal on them and try to keep the same weight and ease of them, they would be the best out here.	1
If thermals were presented with the A goggle, they would be very difficult to beat in combat situations.	3
If you put thermal on this NVG and did not change weight or shape, it would be perfect.	1
They stink because they have no thermal.	1
Not efficient for combat.	1
Should be replaced soon because of the depth.	1
Target picture was difficult to identify in low lit areas.	1
The biggest problem I had was with the prone position. It was extremely hard to keep a sight picture when in the prone. I was having to hold the NODs up manually to scan my area when in the prone.	1
The PVS-14 system is heavy and puts a lot of weight on the neck.	1
Had trouble identifying some targets that thermals would have been easy with.	1

## **ENVG**

Tried and tested. I like the one eyed NOD and these are relatively light. Very important when it comes to long movements. Very important.	1
I like how light it is.	3
Easy to use.	5
I liked how to operate and its overall use.	1
Field test now.	1
Good goggles.	7
Better to identify targets and make quick adjustments.	1
By far better than the others.	2
We need this capability in the field and real situations ASAP. Could save a lot of lives.	1

Characteristics were great.	1
Controls are easy to use and quick to employ, however, the goggles don't turn off in stowed up position.	1
Good design and ease of operation. Very similar to existing NVG, so easy to adapt.	1
I've never been as situationally aware and as comfortable during movement wearing goggles before these.	1
I enjoyed using the B very much. The view and clarity are much better than older models.	1
It isn't very heavy, the picture is very clear, and the controls are easy to use.	1
These are my favorite so far.	2
I thought it was easy to adjust my settings.	2
I had no trouble identifying any of the targets.	1
I would want these goggles in the field.	1
Picture quality and ability to adjust the goggles with the knobs is good.	1
They were very user friendly and allowed for quick effective changes which would make for good results in a combat environment.	1
Has some bugs to be worked out, but excellent overall design.	1
I would definitely like to see these in our arms room, would be nice to have them mounted on the M4 though.	1
I was pleased with everything on this goggle except that it would shut off if it was moved slightly upwards.	1
The Rhino mount needs to have more defined knobs.	1
Thermal I <sup>2</sup> mixture should have some kind of default setting.	1
Encountered slight problem with goggles not recalibrating in thermal between flip down/up (goggles would remain in calibrating screen for several minutes).	1
I would get in the prone position and my flack vest would cause the battery pack to move out of position.	1
If the weight was less and the NVG and thermal overlay was adjusted, it would be a good system.	1
Night vision was weak and thermals were sending small orange blips giving false readings.	1
The only thing I noticed was that the thermal image wouldn't pick up certain things from far away, but up close it was more precise than any other device used this evening.	1
Focus was a little off at far distances as well.	1
The picture quality not as good.	1
When in the prone position, the battery pack kept getting loose.	1
Batteries kept dying.	1
Battery on back is in the way of MICH (modular integrated combat helmet) <sup>5</sup>	1
Weight is still an issue.	3
The Mitch would slide down a tiny bit.	1
It's ok, but the situation awareness problem was aggravating.	1
Battery pack evenly distributes weight over head.	1
The lenses fog up a lot. Is there a way you guys could keep this from happening?	1

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<sup>5</sup>Note: This Soldier was not wearing a MICH; he was wearing an ACH.

5. During this trial did you use mainly I-squared, mainly thermal, or an equal mix of the two?

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
<b>100%</b>	<b>Mostly</b>	<b>Slightly I-</b>	<b>Equal Mix</b>	<b>Slightly</b>	<b>Mostly</b>	<b>100%</b>
<b>I-Squared</b>	<b>I-Squared</b>	<b>Squared</b>		<b>Thermal</b>	<b>Thermal</b>	<b>Thermal</b>

MEAN RESPONSE	
PVS14	ENVG
NA	4.44

## ENVG

Works nicely.	1
Easy to adjust; you can fine-tune it with the knobs.	1
Good thermals.	1
They both were very useful and easy to use.	2
A mix of I <sup>2</sup> and thermal I believe is the best type of sight to use with the NVG.	6
The equal mix made everything easy and quick for scanning.	1
The equal mix made it easy to see both types of targets.	2
Thermals helped pick up targets.	1
Mix is very good and adjustments are easy. One handed operation very good.	1
Liked the way I could set the amount of thermal to I <sup>2</sup> I was using.	1
Mix was good. Targets showed up visibly under thermal; however, thermal tended to blanch out non-thermal targets for me.	1
I could see my laser through the square, so it worked all the time.	1
Thermals worked good. Out of the 3, I think this one mixes the best (alpha being left out without thermals).	1
With no scale in the picture and no awkward buttons to find, identify and press, the two knob system is very easy and comfortable. The Soldier can make on-the-spot adjustments with confidence and ease. However, the thermal wouldn't pick up certain objects.	1
Default setting is needed.	1
Hard to ID targets during both I <sup>2</sup> and thermal.	1
I can detect better with total brightness and half thermal.	1
I had trouble identifying non-thermal targets.	1
It was good for most of it but when looking at certain angles the thermal would dissipate.	1
It was harder at a distance; the thermal wasn't clear.	1
More use to the I <sup>2</sup> than the thermal, so I was using what I was more comfortable with.	1
Thermal box impaired I <sup>2</sup> portion of vision slightly.	1
Thermal sight kept adjusting and was hard to identify targets from far away.	1
Adjustments are too easy to push, making it easy to involuntarily change to full thermal and vice versa.	1
Thermal was too dim at first then the batteries started to die.	1
Very easy to adjust the mix and intensity on the move without hunting for the buttons, you know immediately where and what your looking for and it is ergonomic.	

6. Did you experience any problems using the goggle during this trial? Check all that apply.

No. of Responses		
	PVS14	ENVG
Eye strain	10	16
Tunnel vision	9	6
Headaches	4	5
Motion sickness	0	3
Nausea	0	3
Disorientation	5	2
Dizziness	1	1
Lens fogging	37	24
Screen white-out	16	1

7. Did you experience any other problems with the goggles?

#### AN/PVS-14

Fogged.	4
Losing focus during trial, tried to readjust.	1
Poor up close vision inside buildings.	1
Pulling it down to my face, that's all.	1
Goggles A bounce around a lot while running.	1
Just had to have it really bright to see well.	1
Tilt stinks in the prone.	1

#### ENVG

A little blurry at the end due to fogginess.	3
Night blind.	1
The battery case keeps coming off.	4
The NODs went completely orange.	1
The thermal would turn off.	3
Thermal calibration as described in overall.	1
Just at the beginning.	1
My eyes are blurry after taking them off.	1
Batteries.	3

8. Using the scale below, rate your ability to perform the following tasks during the trial.

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
<b>Extremely hard</b>	<b>Very hard</b>	<b>Hard</b>	<b>Neutral</b>	<b>Easy</b>	<b>Very easy</b>	<b>Extremely easy</b>

TASKS:	MEAN RESPONSE	
	PVS14	ENVG
Movement from building to building	5.49	5.58
Movement within buildings	5.20	5.42
Movement at a quick steady pace	5.45	5.74
Detecting targets in windows	4.16	5.47
Detecting targets in doorways	4.41	5.49
Detecting single targets	4.54	5.63
Detecting multiple targets	4.32	5.64

### AN/PVS-14

Detected targets real well.	4
Nothing I would correct the problem.	1
Using thermals makes it easier to find targets.	1
Detecting open targets was easy.	1
Very familiar with this NVG.	1
These goggles are good but have a big disadvantage because of no thermal imaging.	1
Hard to identify targets.	3
Target detection with these is mediocre, but I would fine tune the sight capabilities of these goggles.	1
Difficult to see inside windows and doors.	6
Hard when dark to detect targets.	3
Multiple targets are also difficult to detect due to visibility changes.	1
It was difficult to see inside of the windows, but it was easy to see doorway silhouettes.	1
It's a bit harder to see the targets with no thermal.	3
Kind of hard to see targets in a urban terrain.	1
These did not outline the target, which stinks for us because the first moments of contact are critical.	1
Need to use laser to be able to ID targets.	1

### ENVG

Overall, good.	2
I had no trouble identifying real human targets.	1
Target acquisition was great and very easy.	8
Didn't really bother me at all.	1
Multiple targets that were thermal showed up quickly.	1
Lightweight and simple enough for a new guy to use them without having to read a manual.	1
You can see targets that were in hidden positions that could not be detected with just night sight.	1
The knobs weren't at all complex to learn.	1
Using the overlay with the thermals turned on enough to see orange clearly made detecting the targets very easy.	1
Battery pack came loose every time I went prone. Need to put detent somewhere else.	1
Brightness was a key factor and was hard to move in the building, but again have to find a good setting.	1

Blurred in and out but returned to normal.	1
When your jogging the thermal picture is blurred making it hard to discern what your looking at.	1
I had trouble identifying the thermal silhouettes; they seemed to blend into the background.	1
It was hard on the move because it was sliding down the whole time. I had to keep it in position with my free hand.	1
Single non-thermal targets hard to detect.	1
Some targets were easy, some not.	1
State of the art.	1
Good, but they were not stable. They kept moving from the position I put them in.	1
The lack of depth perception makes moving from point to point a little difficult.	1
The weight of the goggles tended to push my helmet in front of my face.	1
There's just something weird about the mix. It's a lot harder to tell where things are. Its like I didn't know what I wanted to pay attention to the most. The best tactic for this is probably turning off the thermals before moving.	1
Was a little hard to locate in windows.	1
Couldn't tell if a couple were targets in windows or just the building hot spots.	1



## LAND NAVIGATION

SAMPLE SIZE = 72

1. Please rate the following using the scale below.

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
<b>Extremely bad</b>	<b>Very bad</b>	<b>Bad</b>	<b>Neutral</b>	<b>Good</b>	<b>Very good</b>	<b>Extremely good</b>

GOGGLE CONTROLS:	MEAN RESPONSE	
	PVS14	ENVG
Ease of understanding control function	6.00	5.87
Location of controls	5.94	5.72
Access to controls	5.83	5.61
Ease of activating controls	5.90	5.67
Ease of adjusting mix of thermal and I <sup>2</sup>	NA	5.54
Control settings were maintained during the trial	5.83	5.49

### Comments

### No. of Responses

#### AN/PVS-14

Are great when brand new.	1
Controls are very easy to use.	5
Everything was good with the controls; the settings were maintained throughout the entire use.	1
I like the A because they were easy to work when I was moving and my depth perception was outstanding.	1
In this category, this model has never and still does not present any difficulty.	1
No complaints.	1
Overall really good.	1
Settings did not change during the course of the exercise.	1
Still the best night vision goggles.	1
The controls were very simple and very accessible.	1
These are classic.	1
Tried and tested goggles.	2
These goggles were the best goggle for land navigation; they had the most illumination.	1
They worked well through the whole movement.	1
Very easy to use.	3
Used them too many times before, all answers are based on muscle memory.	1
Very familiar with goggles.	3
While reading map I went through entire range of focusing.	1
Wish I had thermals on these.	1
Would get blurry every now and again.	1
Tube lighting is a bit small, kind of hard to adjust brightness.	1
No thermal.	1
Had to adjust brightness to read map, controls are familiar but not the most accessible.	1

The IR light is in a bad position to turn on. 1

## ENVG

Controls are becoming easier to get used to. 2

Controls are in the right spot for these goggles. 1

Controls worked great. 1

Controls maintained; did not move at all. 1

Controls were very good. 2

The knobs were easy to adjust. 5

Did not have to manipulate the goggles too much. 1

Easy to make the goggles do what you want. 1

I had no problem with the ENVG's; I was rather pleased. 1

In this category, all went well. 1

No complaints. 1

Pretty good for navigation. 1

These are very good goggles. 3

Very good concept needs no work in my eyes. 1

Was able to find controls in the dark. 1

Settings were not maintained during movement. 3

Depth perception was hard. 1

Having diopter adjustment turning with the eyepiece made adjustments difficult. 1

Goggles tend to lose focus during constant use and it is hard to focus for the map reading. 1

Weight could be a little lighter. 1

Stayed on the brightness and no need to adjust. 1

Thermal adjustment is hard to use. 1

Thermal controls were too close to face. 1

The thermal overlay distorts the I<sup>2</sup> to the point of making it difficult to see on a mix mode. 1

The IR should be by the I<sup>2</sup> adjustment knob not by the thermal adjustment knob. 1

Turned thermals all the way off and was constantly adjusting the I<sup>2</sup> to get vision clarity. 1

Focus was a little blurry at its best, also could not get IR flash to operate. 1

Had a little trouble trying to find the buttons on the mount. 1

Hard to get to the IR button with gloves on. 1

The mix of thermal can be difficult at times. 1

The goggles I had kept shutting off for a few seconds at a time; it was more of a flickering on and off very annoying and distracting from my mission. 1

The thermal knob is a little more difficult to adjust because of placement but nothing too major of a problem. 1

After NVG's fell off the Kevlar, they had to be readjusted. 1

GOGGLE MOUNTING:	MEAN RESPONSE	
	PVS14	ENVG
Ease of attaching mount to helmet	5.90	5.57
Ease of attaching goggle to helmet mount	5.90	5.43
Stability of helmet mount	5.35	5.37
Balance of goggle on helmet	5.14	5.32
Wearing comfort	5.04	5.08

## AN/PVS-14

All very good.	1
Excellent.	1
No real problems on wear with this goggle.	1
These goggles had a good comfortable feel to them. Also they were very stable when wearing.	1
If these goggles had the thermal feature they would make all the others obsolete.	1
Mounting bracket is stable and keeps goggles on helmet.	1
The fact that the goggle is light, makes it easier to use.	1
These goggles are very easy to understand but nothing is very comfortable to wear.	1
Too easy.	1
Tried and true; the 14's are the pair I am the most comfortable with and used to.	1
Very comfortable.	1
Very comfortable to move with when moving through the wood line.	2
Too wobbly and unstable.	8
The weight is not balanced enough, tips forward.	5
Headaches galore.	1
I had to keep adjusting the goggles.	1
Mounts tend to get loose over a long period of time.	1
Shake when moving out, fogs easy.	1
Slide from side to side.	1

## ENVG

All around comfortable.	1
Battery pack and NODs have a good balance of weight.	1
Good sturdy mount, got tangled in brush, mount stayed on and held its position.	1
Mounting and comfort was very good.	5
No complaints.	1
The goggles are pretty comfortable and balance well although they are still front heavy.	1
The setup is very good.	1
The weight felt more evenly distributed on this pair of goggles.	1
Very easy.	1
Light and balanced.	1
Like balance to the system, need to be able to space them further forward though.	1
Average comfort, but pretty steady when navigating.	1
Attachment system takes a moment to figure out for eye placement, no other major problems.	1
After a little while you start to get the headache.	1
Battery pack slipped loose a couple of times.	1
Could be lighter and less stressful on the front of the Kevlar.	1
Could not get arm to stay in the bracket.	1
Kind of heavy.	2
Gets hooked on foreign objects easily.	1
Goggles kept falling down.	1
Had a little problem with the mounting – does not fit small helmets very well.	1
If they could be a little lighter that would be good.	1



Ran into a few branches.	2
Sight picture and field of view needs improvement.	1
Snowy picture.	1
The goggle never did really focus right.	1
There were little white dots all over the screen.	1
Used to adjusting for depth perception.	1
Weight caused my neck to be sore from where it weighed down the front.	1
Weight is fine, but clarity could be a little better and field of view.	1

## ENVG

Good goggles.	2
No complaints.	1
If the PVS 14's had thermals these would be it.	1
Had really good depth perception, when having to make NODs brighter it was quick and easy.	1
Overall these goggles are great, easy to stow, and the thermal overlay is good.	1
The clarity was outstanding. The only problem I had was that the thermals crapped out on me once again on this model. I had to turn it off and then turn it back on again.	1
After that, though, I was able to see very well with the I <sup>2</sup> and thermal overlay. When attempting to read the map the goggles were just not able to focus on it. If I stepped back I would focus, but then the map was too far away to read.	
They were easy to use, but I had a hard time with depth perception.	1
Clarity was decent but not overly impressive.	1
Best ones, but still has problems with depth and clarity	1
Bad clarity.	4
Navigation through woods is difficult.	1
Did not use thermal on land navigation.	1
Field of view needs to be larger.	4
Fogged up.	5
Bad depth perception.	3
Goggles sit up too high off the helmet in the stand-by position. They get tangled up too easy. Didn't use thermal at all in this setting.	1
Goggles did not turn off once flipped up.	1
Have trouble focusing up close, on maps for instance.	2
The picture would not come in no matter how much I tried to adjust it.	1
I had to flip it up half way through.	1
Just adjusting the ENVG's are hard.	1
Moisture and fogging precluded a sharp sight picture, angle against face was slightly off as well, had to adjust helmet on head multiple times to correct (skewed, maybe due to improper centering on my part).	1
Needs some more calibration for clarity.	1
Objects seemed closer than they really were, focus was blurry, and thermal would not work, it turned to a full orange square in my view.	
Picture was distorted as if looking through a fish bowl.	2
The eyepiece was too small, I had a lot of tunnel vision.	1
The brightness is kind of light with out the IR.	1
The color of the thermal overlay is good but it can interfere with the I <sup>2</sup> at times. Also, it	

was very difficult for me to read the map with the goggles because they were difficult to focus on something so close.	1
The goggles have lots of weight on the front of helmet making it hard to keep it on your eye where it needs to be.	1
When I was in night vision I could not see that far with the setting was all the way up but it just was not bright.	1
The thermal view is too small, and it is nearly impossible to adjust to read close objects such as maps in I <sup>2</sup> mode even with the IR on.	1
Through thick stuff I lost some depth perception.	1
Tunnel vision set in after a while.	1
Was hard to determine land features through the I <sup>2</sup> and the thermal had no effect on walking.	1

3. How good was your situational awareness -- your knowledge of what was going on around you -- during this trial?

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
<b>Extremely bad</b>	<b>Very bad</b>	<b>Bad</b>	<b>Neutral</b>	<b>Good</b>	<b>Very good</b>	<b>Extremely good</b>

MEAN RESPONSE	
PVS14	ENVG
5.15	5.10

#### AN/PVS-14

Always knew where I was and did not stray off course at all.	1
I could see easily in these goggles.	1
I was aware of my surrounding and also could move at a high rate of speed.	1
Good run with goggles.	1
Could not see vines in front of me, kept getting tangled up	1
Depth perception not good.	1
Field of view limitations inherent to all goggles and lack of picture clarity due to atmospheric conditions were the only problems encountered.	1
Hard to pick out rough terrain.	1
Hard to see underbrush.	2
I could move pretty quick through the brush sometimes the NVGs caught up.	1
I could not see at all due to fog.	1
I couldn't see a drop in the path.	2
I kept getting disorientated; my drift was pretty bad.	1
Situational awareness is limited because of the narrowness of my vision. The ground below me was not the most able to be identified.	1
Sometimes it is really hard to tell what is in front of you.	1
Tended to get tunnel vision, trying to stay on azimuth and keep from tripping on the limbs.	1
The goggles kept on fogging up.	1
We need maps throughout exercise.	1

## ENVG

Was well aware.	1
It was very easy to tell what was where and what everything was.	1
No complaints.	1
Goggles worked fine and could see very well.	1
Sight is very good in these goggles.	1
Was able to keep a good pace with few difficulties.	1
Saw some things and not others.	1
Larger FOV is needed.	1
I could not see the point, but I was able to navigate well.	1
Depth perception was not that good.	2
The goggles kept on fogging up.	4
Did not seem as good due to the clarity problem. Also my peripheral vision seemed a little too confined.	1
Every time I went to adjust the objective focus at all, my I <sup>2</sup> brightness knob spun somewhat.	1
I knew exactly what I was walking into the entire time.	1
I use NODs very little on land navigation.	1
It was hard to tell what was around me and somewhat difficult to move through the brush.	1
Lack of clarity made situational awareness poor.	1
Goggles were blurry the whole time.	1

4. What is your overall rating for the goggle you used for this trial?

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
<b>Extremely bad</b>	<b>Very bad</b>	<b>Bad</b>	<b>Neutral</b>	<b>Good</b>	<b>Very good</b>	<b>Extremely good</b>

MEAN RESPONSE	
PVS14	ENVG
5.23	5.04

## AN/PVS-14

They were almost perfect.	1
Great NODs.	1
Good goggles.	1
Easy to use.	2
Works well and I am proficient with use.	1
I had no problems with this pair of goggles.	1
Overall, it was good.	1
Good clarity could see up close.	1
Good picture and depth perception.	2
I am used to these goggles so it makes it easier to walk at night.	1
The goggles worked very well when I was using them.	1
The PVS-14's are a good stable model. Just need to add thermal and they would be better.	1

They are very good but only because they are brand new.	1
They are easy to use and will get the job done.	1
Good I <sup>2</sup> but still hard to navigate in low illumination.	1
Could have a little bit of better focus on things close up to you.	1
Depth perception bad.	3
Need better mounting system, as old one is too wobbly.	1
Goggles fogged up.	2
Got stuck on NODs when going under brush that I could not see.	1
I was 10 feet from point when I identified it.	1
It was kind of hard to read the compass.	1
Had to use lens cover method to read map accurately and even then it was difficult at best.	1
The helmet mount sliding around was a problem.	1
The clarity was never the best around.	1
This system should be made lighter and made where the lens will not fog up during use.	1

## ENVG

They worked great.	1
Very good.	3
A lot easier to see with than the 14s.	1
Excellent goggles for movement through wooded areas.	1
Goggles worked great for map reading.	1
I like them a lot.	5
Goggle image is clear and controls are easy to use	1
The weight and balance of the goggle is very good and the controls are easy to understand.	2
This was the best goggle for the land navigation course.	1
Very user friendly.	1
Would prefer to use these all the time.	1
Heavy.	2
Battery pack came off during run; got caught up on something.	1
Hard to focus.	2
Could be better at focusing in on closer objects.	1
Had problems navigating I stumbled and tripped a lot I felt disoriented.	1
Knobs are poorly placed and can be thrown off by obstacles too easy.	1
The battery container on the back is easy to knock off and lose.	1
I <sup>2</sup> was not very good at determining land features.	1
The depth perception was bad.	2
Needs better picture.	1
Goggles fog a lot.	4
I think that along with NOD upgrades we need Ballistic Helmet upgrades. I think the headache problem can be remedied with a better K-Pot.	1
Knobs should be tighter or harder to turn and FOV needs to be larger.	1
Problems with picture clarity and brightness caused problems for me with this goggle.	1
Goggles would not focus close enough to read the map and negotiate the grid coordinate reading phase of the lane.	1
The thermal overlay interferes somewhat with the I <sup>2</sup> at times.	1



The weight played a big factor in the testing. And the depth perception was not that good. 1  
I was not very impressed with the range of view or depth perception. 1

5. During this trial did you use mainly I<sup>2</sup>, mainly thermal, or an equal mix of the two?

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
<b>100%</b>	<b>Mostly</b>	<b>Slightly I-</b>	<b>Equal Mix</b>	<b>Slightly</b>	<b>Mostly</b>	<b>100%</b>
<b>I-Squared</b>	<b>I-Squared</b>	<b>Squared</b>		<b>Thermal</b>	<b>Thermal</b>	<b>Thermal</b>

MEAN RESPONSE	
PVS14	ENVG
NA	2.18

#### AN/PVS-14

I am very impressed with a new pair of A goggles. I could read the map. 1  
I could see clearly while moving. 1  
No thermals available. 5  
That is all they had. 2

#### ENVG

Both work very well. 1  
The knob interface is very simple and very quick to use. 1  
The user-friendly design and simplicity of the goggle makes this my #1 choice. 1  
The thermal image was useful and sharp.  
The mix of the two works good, if you're mostly in I<sup>2</sup>, it is even better. 1  
No need for thermal. 10  
Even though I could not see very well, I<sup>2</sup> was the best way to see. 1  
Good mix. 2  
You can see with thermals as well as having great vision through the I<sup>2</sup>. 1  
I did not feel the need to use thermal in the woods. 1  
I put on thermals a tiny bit just to see if I could see some images. 1  
Maybe if I had used thermals it would have been easier to find the point. 1  
No need for thermal on land navigation except threat decision. 1  
I could not read the map.  
Off a little, but good. 1  
Snowy and ugly picture. 1  
Thermal box inhibits I<sup>2</sup> vision unless thermal setting is so low that you can barely see anything. 1  
The lowest setting on the thermal takes a little too much away from the I<sup>2</sup> image. 1  
Thermal made picture worse. 1  
Thermal went out. 2  
Wound up turning off the thermal overlay about halfway in due to calibration and brightness issues. 1

6. Did you experience any problems using the goggle during this trial? Check all that apply.

No. of Responses		
	PVS14	ENVG
Eye strain	14	19
Tunnel vision	15	14
Headaches	5	9
Motion sickness	1	1
Nausea	0	1
Disorientation	2	7
Dizziness	1	4
Lens fogging	34	30
Screen white-out	0	0

7. Did you experience any other problems with the goggles?

#### AN/PVS-14

No problems.	8
Lens fogging a lot.	4
Mount started to loosen up.	1

#### ENVG

Battery compartment came off easily.	2
Could not focus good enough to read grid numbers.	1
Kept getting foggy.	4
No IR when pressed the button.	1
On I <sup>2</sup> hard to find target.	1
Thermals go out.	1
This set had almost an orange haze.	1

8. Using the scale below, rate your ability to perform the following tasks during the trial.

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
<b>Extremely hard</b>	<b>Very hard</b>	<b>Hard</b>	<b>Neutral</b>	<b>Easy</b>	<b>Very easy</b>	<b>Extremely easy</b>

TASKS:	MEAN RESPONSE	
	PVS14	B
Movement across rough ground	4.54	4.53
Movement at a quick steady pace	4.93	4.83
Identifying terrain features	4.80	4.87
Reading compass	4.17	3.71
Reading map	4.01	2.54

#### AN/PVS-14

Implement the clarity of these goggle's I <sup>2</sup> feature on B and that will be he perfect goggle.	1
Reading map was relatively easy	2
This was a better map-reader than the B model, but it was still very trying.	1
These where the only one so far I could see the map well and the compass very well.	1
Terrain was very rough but vision was good.	1
No problems with identifying the terrain.	1
Fairly easy to read map with IR light on.	2
I could make out details such as holes and weeds and very easy to walk with.	1
I could read a map with difficulty.	3
Found it easier to read a map with the lens cap on.	3
Hard to read the map.	5
Hard to read compass.	3
Goggles fogged.	4
Hard to focus.	3
As with the other goggles I could make out the terrain features on the map, but not the grid.	1
You could not make out the terrain or features of the land at all.	1
The only thing that could be made out is the outline of everything in front no matter if it was near or far.	1
Field of view and depth perception were horrible.	1
Focusing on objects closer to face could be better.	1
Hard to read small numbers.	4
I tripped a lot.	1
On the map I could see the circle and the intersection but not the grid line numbers.	1
Compass reading done mostly with the uncovered eye due to illumination strips inside compass.	1
Still cannot read the compass or map with my eye that the NODs are mounted on.	1
Sight picture not very clear up close, if could be fixed would be very good; over all it was easy to move and judge but sight could use a little more clarity.	1
The glow from the compass will always overpower the I <sup>2</sup> .	1
Tunnel vision and depth perception were a problem.	1

#### ENVG

Could see the map pretty well.	1
I really value the fact that you still have one eye open, that you may be able to do minute things; such as read a compass.	1
It was ok traveling with the goggles.	1
I read the map extremely easy with the B.	1
The NODs were good and could identify the terrain when properly adjusted .I would have been able to see the map better if I had the day lens cover.	1
For most tasks preformed they neither helped nor hurt my performance.	1
Used uncovered eye to read compass. Had to hold map too far away to read in order to focus.	1
Took a little time to adjust to be able to read the map.	1
Reading the map was difficult but other than that they were good.	1

Very hard to read map.	20
Very hard to read compass.	10
Focusing was difficult.	5
Compass reading accomplished with unaided eye, needed to use lens cover method to read map and even then I still could not identify the grid numbers accurately due to fog and picture clarity.	1
Goggles fogged.	3
Could barely see detail in tree formations much less read from a map or compass.	1
Lack of clarity made movement difficult at a quick and steady pace.	1
The IR was not working on my goggles.	1
Could not do anything.	1
Couldn't really see to well at a close distance.	1
Could not move quickly because the field of view was too narrow.	1
Focused on map but could not identify small numbers. Map was far during focus, was awkward.	1
Goggles need to be able to focus to about 8 to 10 inches.	1
I could not read the maps numbers.	1
I could not see anything at all. The only clear field of vision was 5 feet in front of me.	1
Reads letter direction but not numbers.	1
The depth perception was not good.	3
When I ran into the edge of a wall of vegetation I became really disoriented and it took me about 5 minutes to figure out what I was looking at and regain my composure.	1
With the goggles we use today (PVS-14's) to read maps at night I use the daytime cap in order to read the map. I use the same technique with the bravo NODs. They worked great. If we were to get them that should be in the TM.	1

## MOUT ATTACK

SAMPLE SIZE = 70

1. Please rate the following using the scale below.

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
<b>Extremely bad</b>	<b>Very bad</b>	<b>Bad</b>	<b>Neutral</b>	<b>Good</b>	<b>Very good</b>	<b>Extremely good</b>

GOGGLE CONTROLS:	MEAN RESPONSE	
	PVS14	ENVG
Ease of understanding control function	5.85	5.63
Location of controls	5.81	5.50
Access to controls	5.75	5.65
Ease of activating controls	5.75	5.76
Ease of adjusting mix of thermal and I <sup>2</sup>	NA	5.52
Control settings were maintained during the trial	5.78	5.54

### Comments

### No. of Responses

#### **AN/PVS-14**

All good.	1
Controls were maintained; I didn't have to keep readjusting.	2
Liked the buttons, controls.	1
Quick and easy.	2
Small, perfectly clear and bright. These things are the best in terms of fighting on the move. Even without thermal capabilities, these NVGs would be my choice in a tactical engagement.	1
There is no way to see through a smoke screen if we're to be attacked by smoke.	1
Used them for 2 yrs.	1
Need thermal.	2

#### **ENVG**

These goggles are the best so far.	1
Buttons are easy.	2
Controls are user friendly.	1
Controls were maintained and quick and easy to adjust.	2
Very few switches.	1
I fully understood the controls of these goggles.	1
Took a second to locate the knobs, but that is from not working with them enough.	1
Thermal settings were not maintained.	1
Thermals kept going in and out.	1
Too easy to involuntarily make a wrong adjustment.	3
Adjusting the thermal mix is difficult.	3
Did lots of adjusting with the thermals intensity.	1

When I went in to the room every thing was black. Opposing forces (OPFOR) did not register on my NODs at all even after I died I tried to find them.	1
The thermal didn't work all the time. I could see good around the edge but not in the center on both mixed and just thermal.	1
The thermal over-powered the I <sup>2</sup> for about 30-45 seconds.	1
Cut out.	1

GOGGLE MOUNTING:	MEAN RESPONSE	
	PVS14	ENVG
Ease of attaching mount to helmet	5.78	5.65
Ease of attaching goggle to helmet mount	5.64	5.65
Stability of helmet mount	5.46	5.69
Balance of goggle on helmet	5.42	5.40
Wearing comfort	5.42	5.18

### AN/PVS-14

All good.	1
The most comfortable of the three goggles.	1
Lightest of the three models.	1
Unbalanced, but good.	1
Very comfortable.	1
I didn't have any problems with the wear of these goggles.	1
I had to jack up my K-pot.	1
The j-hook to the helmet mount is extremely wobbly.	1
Wobbly and loose.	1

### ENVG

Sweet goggles.	1
Easy to mount and are balanced.	1
Light and comfortable.	2
I didn't have to adjust with my hands or jack up my k-pot. <sup>6</sup>	1
These had little movement when moving from building to building.	1
Battery pack is not mounted securely enough; a small collision will knock it off.	1
Loose.	1
Could not adjust to my preference.	1
Little nose heavy, but not too bad.	1
Heavy and uncomfortable.	4
Strain on the forehead.	1
Some of the buttons stick when trying to move the ENVGs.	1

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<sup>6</sup>K-pot is slang for Kevlar helmet.

2. Please rate the following characteristics using the scale below.

1	2	3	4	5	6	7
Extremely bad	Very bad	Bad	Neutral	Good	Very good	Extremely good

CHARACTERISICS:	MEAN RESPONSE	
	PVS14	ENVG
Weight of goggle	5.38	5.03
Shape of goggle	5.62	5.29
Adequacy of field of view	5.19	4.99
Ability to perceive depth	4.96	4.91
Sight picture brightness	5.44	5.25
Sight picture clarity	5.24	4.85
Color of thermal overlay	NA	5.20
Ease of eyepiece adjustment	5.68	5.48
Ease of stowing goggle in flip-up position	5.91	5.85
Once stowed, goggle maintains flip-up position	5.97	5.88
Overall ease of use	5.69	5.53

# AN/PVS-14

Work beautifully.	1
A good baseline model.	1
Easy to use.	3
Good clear picture.	2
Couldn't see through fog or walk.	2
Smoke was problematic.	2
They were good until I got into the smoke.	1
Could have used thermals.	1
Not as heavy, but I still had to push them up a few times.	1
Hard to perceive depth.	1

## ENVG

Good goggle all around.	2
Good ability to control I <sup>2</sup> /thermal ratio.	1
Very easy to use; making adjustments on the fly was easy.	1
Worked fine; easy and quick to mount.	1
Overlay is quite nice.	1
The goggles were very clear when using them.	1
Stable.	1
No matter what, in the smoke you're going to get turned around. But with the thermals it's a lot easier to get yourself righted. When your relying solely on thermals your depth perception is null.	1
Color of thermal is poor.	2
Could use more brightness and clarity.	4
Field of view is small and blurry.	4

Thermal overlay was not clear in a MOUT environment.	1
I <sup>2</sup> brightness dimmed a couple of times.	1
It was very hard to see with the goggles from far to near.	1
Things seem farther away than they really are, IR wont get bright enough.	1
Once fogged up, thermal doesn't work.	1
Still a little heavy.	1
The diopter focus moves the eyecup and vice versa.	1
There is a halo around the goggle where the lens would meet the plastic in front.	1
Thermal overlay clouds I <sup>2</sup> .	2

3. How good was your situational awareness -- your knowledge of what was going on around you -- during this trial?

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
<b>Extremely bad</b>	<b>Very bad</b>	<b>Bad</b>	<b>Neutral</b>	<b>Good</b>	<b>Very good</b>	<b>Extremely good</b>

MEAN RESPONSE	
PVS14	ENVG
5.07	5.12

#### AN/PVS-14

I could tell where I was the whole time.	1
Smoke slightly deteriorated my situational awareness, but sight picture was very clear otherwise.	1
Couldn't see anything in the smoke.	11
Could have used thermals upstairs.	1
I missed the thermal.	1

#### ENVG

I was aware; could see almost everything.	3
Thermal worked pretty good.	1
Saw through fog.	1
Very good I <sup>2</sup> ; just couldn't get a thermal when moving fast unless right on top of enemy.	1
Could not see through smoke.	3
Couldn't get a good clear picture with my NODs.	1
Had to offset the direction I was looking to get thermal into view.	1
Lost view when I went in to the room.	1
The small thermal viewer screen compared to your overall field of view tends to give you tunnel vision.	1
When in motion it was difficult.	1





I<sup>2</sup> all the way. 1  
 I think that the alpha has a good eye sight picture and are very light, if only they could 1  
 put thermals in alpha at it's weight.  
 No thermal sights. 3  
 Need thermal. 1

### ENVG

Knob system is great. 1  
 I used equal mix; it worked very well. 1  
 The thermals work real well when on the move. 1  
 The thermal over-powered the I<sup>2</sup> a little. 1  
 Thermal works well for target detection, dominant and non-dominant eye causes offset 1  
 in view however.  
 Easier to move only using slight thermal. 1  
 I believe that thermal may not be needed. 1  
 Just enough to use thermal, but the I<sup>2</sup> wouldn't be present. 1  
 Mix. 1

6. Did you experience any problems using the goggle during this trial? Check all that apply.

No. of Responses		
	A	ENVG
Eye strain	6	9
Tunnel vision	4	9
Headaches	1	5
Motion sickness	0	0
Nausea	0	0
Disorientation	2	7
Dizziness	0	0
Lens fogging	16	20
Screen white-out	0	1

7. Did you experience any other problems with the goggles?

### AN/PVS-14

I died at the woodline. 1  
 Smoke was a bad. 1

### ENVG

Double image once they fogged up. 1  
 Major lens fogging. 1  
 Need to push out farther. 1  
 When in motion, it was difficult to see. 1

8. Using the scale below, rate your ability to perform the following tasks during the trial.

1	2	3	4	5	6	7
Extremely hard	Very hard	Hard	Neutral	Easy	Very easy	Extremely easy

TASKS:	MEAN RESPONSE	
	PVS14	ENVG
Move over rough terrain	5.22	5.23
Move at a quick steady pace	5.28	5.37
Move between buildings	5.10	5.37
Move within buildings	5.08	5.08
Identify specific buildings	5.00	5.39
Identify right and left road boundaries	5.06	5.33
Maintain visual contact with squad members	4.83	5.24
Scan sector	4.90	5.37
Detect targets	4.72	5.49
Identify targets	4.52	5.41
Engage targets	4.83	5.52
Quickly adjust to sudden bright light (e.g., flares)	4.79	5.19

9. Was there a lag or delay between the thermal & I-squared images when you moved your head?

	Yes	No	NR
AN/PVS-14	<b>no data</b>	no data	
ENVG	38	28	4

## MOUT DEFEND

SAMPLE SIZE = 70

1. Please rate the following using the scale below.

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
<b>Extremely bad</b>	<b>Very bad</b>	<b>Bad</b>	<b>Neutral</b>	<b>Good</b>	<b>Very good</b>	<b>Extremely good</b>

GOGGLE CONTROLS:	MEAN RESPONSE	
	PVS14	ENVG
Ease of understanding control function	5.88	5.68
Location of controls	5.81	5.64
Access to controls	5.75	5.67
Ease of activating controls	5.78	5.68
Ease of adjusting mix of thermal and I <sup>2</sup>	NA	5.54
Control settings were maintained during the trial	5.90	5.55

### Comments

### No. of Responses

#### **AN/PVS-14**

Good overall.	1
Controls were easy.	3
Locations and activating controls were easy.	1
Easy to mount and dismount.	1
Good design.	1
Liked the settings.	1
Very familiar with goggles.	2
Could not see anything during the attack due to the fact that there were no thermals.	1

#### **ENVG**

Everything worked fine.	1
Buttons are good.	1
Easy access to the controls.	2
Easy to maintain; use.	2
Easy to use settings; stayed the same.	1
Very easy to switch between thermal.	1
Knobs turn too easily; too easy to inadvertently change settings (bumping).	2
Never changed settings.	1
Thermal adjustment needs work.	1
Upped thermal to detect targets in smoke.	1

GOGGLE MOUNTING:	MEAN RESPONSE	
	PVS14	ENVG
Ease of attaching mount to helmet	5.85	5.71
Ease of attaching goggle to helmet mount	5.87	5.51
Stability of helmet mount	5.63	5.51
Balance of goggle on helmet	5.51	5.36
Wearing comfort	5.46	5.35

#### AN/PVS-14

All around comfortable.	1
It is very easy attaching these goggles to the Kevlar.	1
Mounting easy.	1
Very stable.	1
Very used to this goggle.	1
All the weight is all to the front.	1
It was heavy on the head and uncomfortable on the forehead.	1
Not comfortable to wear; the weight brought the k-pot down my head a little bit.	1
Female bracket was loose.	1
It can sometimes get annoying putting the j-hook on the mount, and its also very flimsy.	1
Kind of unbalanced.	1
Swing arm needs to be adjusted so it can be tightened more.	1

#### ENVG

Comfy and stable.	1
Easiest to attach.	1
Easy to adjust.	1
Well balanced.	2
Nice and comfortable.	2
Stayed where they were supposed to be.	1
Attachment is too fragile. So are the connections.	1
Loose.	1
They shake and move up and down.	1
Goggles fell off during exercise.	1
Very heavy.	3
To much weight to the right front of the Kevlar.	1

2. Please rate the following characteristics using the scale below.

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
<b>Extremely bad</b>	<b>Very bad</b>	<b>Bad</b>	<b>Neutral</b>	<b>Good</b>	<b>Very good</b>	<b>Extremely good</b>

CHARACTERISTICS:	MEAN RESPONSE	
	PVS14	ENVG
Weight of goggle	5.44	5.12
Shape of goggle	5.59	5.30
Adequacy of field of view	5.26	5.19
Ability to perceive depth	4.94	5.19
Sight picture brightness	5.41	5.36
Sight picture clarity	5.32	5.25
Color of thermal overlay	NA	5.32
Ease of eyepiece adjustment	5.63	5.64
Ease of stowing goggle in flip-up position	5.99	5.81
Once stowed, goggle maintains flip-up position	6.06	5.90
Overall ease of use	5.71	5.63

### AN/PVS-14

Easy to use.	2
It was clear - I could tell depth.	1
Familiarity makes use easier, I <sup>2</sup> seems better than both other prototypes on this model.	1
Sight picture good, no thermals though.	1
Good except in the smoke.	2
White hot is very effective.	1
I like old 14's the best: best sight, clarity, don't fog.	1
Maybe needs a little more field of view.	1
No clearness, and at a distance it still takes some straining to tell whether its a target or not if its stationary.	1
No thermal usage.	1
Weight of the goggle pulls down on the front of helmet and causes neck strain.	1
When they are stowed, they are stowed.	1

### ENVG

Best of all goggles.	1
Great piece of equipment.	3
Easy to understand; use.	2
Light.	1
Stows easily.	1
Hard to see through smoke.	1
I <sup>2</sup> won't turn bright enough for my liking.	1
Very bright thermal.	1
Thermals not strong enough.	1
Thermal only picks up at a certain distance.	1
Field of view was fairly narrow.	3
The thermal is too narrow.	1
Not a good picture.	2
Blur at a distance even when focused, sight picture clarity a blur.	3
The goggles stick up way too high when they're in the stowed position.	1

Thermal overlay leaves residual images in corners. 2  
Weight could be lighter. 1

3. How good was your situational awareness -- your knowledge of what was going on around you -- during this trial?

1 2 3 4 5 6 7  
Extremely Very bad Bad Neutral Good Very good Extremely  
bad good

MEAN RESPONSE	
PVS14	ENVG
5.37	5.50

#### AN/PVS-14

Great!!!! 1  
Could see well. 3  
Once the enemy was close I knew where they were. 1  
Outside of smoke, was clear and easy to see. 2  
Could not see through smoke. 5  
Very easy to keep depth perception and stay alert. 1

#### ENVG

I could see what was happening the entire time. 3  
Saw through fog. 1  
Thermal detection worked very well in smoke with these goggles. 1  
Couldn't see much even with the thermals. 1  
Tended to get tunnel vision with the small thermal sight picture. 1

4. What is your overall rating for the goggle you used for this trial?

1 2 3 4 5 6 7  
Extremely Very bad Bad Neutral Good Very good Extremely  
bad good

MEAN RESPONSE	
PVS14	ENVG
5.19	5.51

#### AN/PVS-14

Can see how thermals would be of use. 1  
They were good in the defense. 1  
Easy use and smoke didn't really bother me. 1  
Good. 3  
I couldn't see through the fog/smoke. 2

Real Soldiers wouldn't be using NVG's to clear rooms; we use white light attached to weapons. 1  
 Could not see in smoke. 4

## ENVG

Better than attacking. 1  
 Thermals were good. 1  
 Good goggle. 2  
 I saw through the smoke clearly and accurately. 1  
 These goggles focus decently, both up close and far away. 1  
 I liked them a lot. 1  
 It is a lot easier to have a sight picture that is dependable while you are not moving. 1  
 Only problem is they need to push out forward more. 1  
 The only problem I had was when you turned on the I<sup>2</sup>, the thermal would lose its detail. 1  
 That really stunk.  
 The outer lens is kind of blurry while the inner is good. 1  
 There was a constant flash in the goggles. 1  
 Clarity of picture, weight, field of view not very good. 1  
 Thermal image was easily disrupted when the goggles were flipped down or jostled. 1

5. During this trial did you use mainly I-squared, mainly thermal, or an equal mix of the two?

1 100% I-Squared	2 Mostly I-Squared	3 Slightly I- Squared	4 Equal Mix	5 Slightly Thermal	6 Mostly Thermal	7 100% Thermal
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MEAN RESPONSE	
PVS14	ENVG
NA	4.75

## AN/PVS-14

14's. 1  
 Good. 1  
 Need thermal. 1

## ENVG

The knobs are great. 1  
 Didn't have any problems seeing through the fog with thermals. 1  
 I only used my I<sup>2</sup> to see the lasers. 1  
 The thermals helped when looking through the smoke. 2  
 Mostly thermal, cannot see thermals well with I<sup>2</sup>. 1  
 The thermals override the I<sup>2</sup> to the point of only being able to identify the target by the thermals. 2  
 Thermal square was always present. 1  
 Upped thermal to a moderately high level when smoke billowed across area. 1



I hate the fact that the goggles would go to standby like a couple of seconds after you put them up. Then you would have to reset the goggles all over again. 1

6. Did you experience any problems using the goggle during this trial? Check all that apply.

No. of Responses		
	PVS14	ENVG
Eye strain	10	9
Tunnel vision	2	9
Headaches	4	4
Motion sickness	0	0
Nausea	0	0
Disorientation	0	2
Dizziness	13	2
Lens fogging	0	9
Screen white-out	9	0

7. Did you experience any other problems with the goggles?

#### AN/PVS-14

Couldn't see through fog. 1  
Only this good because they are new. 1  
Smoke! 1

8. Using the scale below, rate your ability to perform the following tasks during the trial.

1 2 3 4 5 6 7  
Extremely Very hard Hard Neutral Easy Very easy Extremely  
hard easy

TASKS:	MEAN RESPONSE	
	A	ENVG
Move over rough terrain	4.98	4.84
Move at a quick steady pace	5.12	4.93
Move between buildings	5.07	5.09
Move within buildings	5.07	5.21
Identify specific buildings	5.32	5.45
Identify right & left road boundaries	5.20	5.52
Maintain visual contact with squad members	5.13	5.59
Scan sector	5.08	5.57
Detect targets	4.78	5.69
Identify targets	4.69	5.69
Engage targets	4.94	5.72
Quickly adjust to sudden bright light (e.g., flares)	4.93	5.29

## NIGHT QUALIFICATION

SAMPLE SIZE = 55

1. Please rate the following using the scale below.

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
<b>Extremely bad</b>	<b>Very bad</b>	<b>Bad</b>	<b>Neutral</b>	<b>Good</b>	<b>Very good</b>	<b>Extremely good</b>

GOGGLE CONTROLS:	MEAN RESPONSE	
	PVS14	ENVG
Ease of understanding control function	6.02	5.74
Location of controls	5.89	5.63
Access to controls	5.93	5.69
Ease of activating controls	5.85	5.81
Ease of adjusting mix of thermal and I <sup>2</sup>	NA	5.54
Control settings were maintained during the trial	5.83	5.39

### Comments

### No. of Responses

#### **AN/PVS-14**

Everything worked fine.	1
Very clear picture.	1
I had no problem with the controls.	1
If you were to keep the A and add the high-speed thermal addition, that would be a nice goggle to work with.	1
Familiar with this goggle's control system.	2
I could not shift from left to right with ease.	1
It was foggy out on the range; I couldn't see anything past 100 meters.	2

#### **ENVG**

I had no problems with the controls other than the thermals kept bleeping in and out.	1
Thermal overlay and I <sup>2</sup> were not on top of each other.	1
Became blurry throughout the live fire.	1
I had to keep adjusting the focus during the firing.	2
Knobs are too easy to move, inadvertently adjust.	2
No thermal usage.	1
Somehow the thermal kept on shutting off during the shoot.	1
Thermal setting adjusted down by itself when I exited the foxhole.	1
Was in wrong thermal mode and didn't notice until I didn't acquire any targets.	1
With the heat from the weapon, it caused my thermals to get too bright so that I wasn't able to see anything.	1

GOGGLE MOUNTING:	MEAN RESPONSE	
	PVS14	ENVG
Ease of attaching mount to helmet	5.93	5.60
Ease of attaching goggle to helmet mount	5.91	5.55
Stability of helmet mount	5.35	5.34
Balance of goggle on helmet	5.35	5.09
Wearing comfort	5.28	4.98

#### AN/PVS-14

Nice feel; didn't push Kevlar down.	1
The goggles are very easy to mount on the Kevlar.	1
Goggles jiggled around a lot.	1
Vertical axis wobbly and needs to be manually adjusted.	1
Hard to fire in the prone position because the weight is forward of the helmet.	2
K-pot kept sliding over my eyes.	1

#### ENVG

Easy and quick to mount.	1
Heavy.	2
It kept moving down on me and also the weight was starting to give me a headache.	1
Had problems with goggles staying in place while in the prone.	4
The goggle actually slid down on my face some.	2
Put some strain on forehead.	1
They are a little bit uncomfortable.	1
Battery pack digs into the back of my head.	1
Too many parts to fool with and/or lose.	1
The picture was not clear enough to engage 150 m+.	1

2. Please rate the following characteristics using the scale below.

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
<b>Extremely bad</b>	<b>Very bad</b>	<b>Bad</b>	<b>Neutral</b>	<b>Good</b>	<b>Very good</b>	<b>Extremely good</b>

CHARACTERISTICS:	MEAN RESPONSE	
	PVS14	ENVG
Weight of goggle	5.37	4.79
Shape of goggle	5.57	5.30
Adequacy of field of view	5.28	4.98
Ability to perceive depth	5.04	5.02
Sight picture brightness	5.31	5.06
Sight picture clarity	5.09	4.66
Color of thermal overlay	NA	5.26
Ease of eyepiece adjustment	5.47	5.32
Ease of stowing goggle in flip-up position	5.85	5.85

Once stowed, goggle maintains flip-up position	5.85	5.83
Overall ease of use	5.63	5.38

#### AN/PVS-14

You could see through them easy if you see a target.	1
I <sup>2</sup> for these goggles is better than the prototypes.	1
Very easy to see and stow.	1
Fogging degraded picture clarity.	4
Goggles started to fog up so I had to pull them out away from the face, had to do this almost all the time since I started using A goggles in '98.	1
Had trouble keeping my head up; a little heavy.	2
They felt heavy when firing from the prone position. I had to lift my head way back to prevent them from slipping down.	1
Needed thermals to pick up targets over 200m.	1
Wish I could adjust clarity.	1
Would not focus right.	1

#### ENVG

A little bit heavy.	3
The goggles felt heavy and awkward when firing from the prone position. They pulled my helmet down and distorted my view. I constantly had to push them back up. When they slip down, the sight picture becomes a blurry, orange tint, and that is with no thermal.	2
Too big.	1
Had problems with the ghost effect when I would go from one target to the other.	2
Narrow field of view with thermal.	2
Goggles fogged.	2
Need to be able to focus better and make the view brighter.	1
The only problem was that the thermals kept bleeping in and out.	1
Thermal overlay leaves residuals in corners, blurs I <sup>2</sup> .	1
Thermal overlay overpowers I <sup>2</sup> .	1
Thermal seemed to dance a little on the actual target so it was necessary to adjust the location of the aiming light.	1
With thermal the target moved as my head moved and it blurred my vision.	1
Picture was bad.	1
The thermal tends to take all of the shooter's attention which is bad.	1
Had a halo-like look on edges.	1

3. How good was your situational awareness -- your knowledge of what was going on around you -- during this trial?

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
<b>Extremely bad</b>	<b>Very bad</b>	<b>Bad</b>	<b>Neutral</b>	<b>Good</b>	<b>Very good</b>	<b>Extremely good</b>



5. During this trial did you use mainly I-squared, mainly thermal, or an equal mix of the two?

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
<b>100%</b>	<b>Mostly</b>	<b>Slightly I-</b>	<b>Equal Mix</b>	<b>Slightly</b>	<b>Mostly</b>	<b>100%</b>
<b>I-Squared</b>	<b>I-Squared</b>	<b>Squared</b>		<b>Thermal</b>	<b>Thermal</b>	<b>Thermal</b>

MEAN RESPONSE	
PVS14	ENVG
NA	4.00

#### AN/PVS-14

Has no thermal.	2
It was hard using the goggles during this trial. I couldn't see anything from 150 meters and out.	1
The lack of thermal made it impossible to detect targets in the thick fog.	1

#### ENVG

The sight picture was good, but I had a problem with the goggle moving out of place when I was in prone unsupported.	1
Higher thermal mix for target detection.	1
I used more thermal than anything else to see the targets.	1
Seemed like thermal was offset from actual target and 300m target could not see.	1
The thermal picture was kind of off to the right of the actual target.	1
Thermal and I2 do not overlap just right making it hard to engage targets with IR laser.	1
I fogged up so bad that the only thing I could see was the thermals.	1
If you brought the weapon up closer to the line of sight of the goggles, the heat of the weapon drowned out the heat from the targets.	1
Parallax made it difficult to engage targets.	1
When I was in the prone position the goggles got very heavy.	1

6. Did you experience any problems using the goggle during this trial? Check all that apply.

No. of Responses		
	PVS14	ENVG
Eye strain	8	11
Tunnel vision	4	5
Headaches	4	8
Motion sickness	0	0
Nausea	0	0
Disorientation	0	2
Dizziness	0	0
Lens fogging	31	19
Screen white-out	0	0

AN/PVS-14

# ENVG

8. Using the scale below, rate your ability to perform the following tasks during the trial.

1	2	3	4	5	6	7
Extremely hard	Very hard	Hard	Neutral	Easy	Very easy	Extremely easy

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## AMBUSH

SAMPLE SIZE = 120 (2 DAYS)

1. Please rate the following using the scale below.

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
<b>Extremely bad</b>	<b>Very bad</b>	<b>Bad</b>	<b>Neutral</b>	<b>Good</b>	<b>Very good</b>	<b>Extremely good</b>

GOGGLE CONTROLS:	MEAN RESPONSE	
	PVS14	ENVG
Ease of understanding control function	5.76	5.65
Location of controls	5.70	5.56
Access to controls	5.69	5.63
Ease of activating controls	5.76	5.68
Ease of adjusting mix of thermal & I <sup>2</sup>	NA	5.50
Control settings were maintained during the trial	5.78	5.48

### Comments

### No. of Responses

#### **AN/PVS-14**

Picture was clear the whole time.	1
Buttons are good to go.	1
Easy and light.	1
Great sight picture.	1
Very simple to use which is nice.	1
Everything was maintained during ambush.	1
Muscle memory.	1
It was a little difficult to adjust the thermal settings with the rubber eyepiece flipped forward with gloves on. The rubber piece got in the way.	1
Controls stayed the same.	1
No thermal.	1

#### **ENVG**

Knob system works well and is very easy to use.	2
The more I use them, the better they are to find.	1
Thermals were full up the whole time.	1
Goggle's thermal screen flickered off when bumped.	1
Thermal cut out and had to recalibrate.	2
The I <sup>2</sup> adjustment knob is in a bad place. It's too easy to hit when adjusting the goggle, which throws off the mix.	1
Kind of hard to adjust with a little amount of time.	1
Lowered thermal due to feedback from surrounding ground and trees.	1
Problems with thick foliage.	1
Slight delay in the thermals when I moved my head fast.	1
The weight needs to be less.	1



GOGGLE MOUNTING:	MEAN RESPONSE	
	PVS14	ENVG
Ease of attaching mount to helmet	5.72	5.65
Ease of attaching goggle to helmet mount	5.63	5.55
Stability of helmet mount	5.35	5.46
Balance of goggle on helmet	5.24	5.33
Wearing comfort	5.23	5.23

#### AN/PVS-14

The screw plate is everyone's favorite.	1
All the weight is at the front.	1
Bounced around.	3
Didn't push down.	1
Needs more stability.	1
Unbalanced.	1
The goggle is a good item to use except for the fact that if there were thermals, then I would have detected sooner.	1
The mount came loose, those straps have to go.	1
The NODs were very uncomfortable. Just laying there for a few minutes, it got to the point where I had to pull my K-pot higher on my head.	2
NVG's fell off.	1

#### ENVG

Easiest to mount.	1
I had to keep sliding my Kevlar side to side to keep it balanced; with that it was uncomfortable.	1
Some strain on the forehead.	1
I still think that the goggle to helmet mount is a little too fragile.	1
K-pot kept falling down my face.	1
The vertical axis moving the NOD up and down was loose and kept having to be manually moved by hand.	1
Vertical adjustment slid up too easily when bumped.	1
Too heavy.	3

2. Please rate the following characteristics using the scale below.

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
<b>Extremely bad</b>	<b>Very bad</b>	<b>Bad</b>	<b>Neutral</b>	<b>Good</b>	<b>Very good</b>	<b>Extremely good</b>

CHARACTERISICS:	MEAN RESPONSE	
	PVS14	ENVG
Weight of goggle	5.29	5.17
Shape of goggle	5.42	5.38
Adequacy of field of view	5.37	5.23

Ability to perceive depth	5.12	5.25
Sight picture brightness	5.40	5.31
Sight picture clarity	5.35	5.28
Color of thermal overlay	NA	5.34
Ease of eyepiece adjustment	5.55	5.48
Ease of stowing goggle in flip-up position	5.85	5.83
Once stowed, goggle maintains flip-up position	5.88	5.84
Overall ease of use	5.61	5.63

#### AN/PVS-14

Clear picture.	3
Good goggles.	1
Diopter focus is nonexistent.	1
Goggle weighs Kevlar down.	1
I think that the NODs would benefit greatly with an advancement in our ballistic helmets. The helmet would slip down on your head and throw your sight picture off.	1
The clarity wasn't too great.	2
You can never see details; it just gets worse the closer the target is.	1
The goggles fogged up quick.	2
Thermal would be very useful because you could conceal your position more and be capable of engaging your target.	3

#### ENVG

I find these goggles are the easiest to use and focus.	1
Great thermal.	1
Clarity of sight picture is kind of bad.	2
Field of view is too small.	3
Picture is blurry around the edges.	7
I <sup>2</sup> is terrible.	1
It was a little heavy.	3
Weight makes it pull down on the goggle.	1
While in the prone, the weight of the goggle is really noticeable, in a bad way.	1
Too much overlay.	1
The color of the thermal overlay is too dark and it interferes with the I <sup>2</sup> .	1
Thermal was too bright.	1
Needs to be able to get brighter.	1
Wouldn't have seen them without thermals.	1

3. How good was your situational awareness – your knowledge of what was going on around you – during this trial?

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
<b>Extremely bad</b>	<b>Very bad</b>	<b>Bad</b>	<b>Neutral</b>	<b>Good</b>	<b>Very good</b>	<b>Extremely good</b>

MEAN RESPONSE	
PVS14	ENVG
5.42	5.50

#### AN/PVS-14

Was able to see around me the whole time.	2
It's hard to pick things up through the brush, but it was pretty easy picking up the movement.	2
Awareness low in heavily vegetated terrain without thermal.	1
Goggles don't provide a lot of situational awareness.	3
No thermals.	1

#### ENVG

The goggle fogged up almost instantly, but the thermal seemed to be fine even through the brush and fog.	1
--	---

4. What is your overall rating for the goggle you used for this trial?

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
<b>Extremely bad</b>	<b>Very bad</b>	<b>Bad</b>	<b>Neutral</b>	<b>Good</b>	<b>Very good</b>	<b>Extremely good</b>

MEAN RESPONSE	
PVS14	ENVG
5.20	5.34

#### AN/PVS-14

Good for detecting enemy.	1
They are good goggles.	2
You cannot see until they are up close.	1
Battery cap was not tight; goggle went off when cap came loose and had to hold with my hand.	2
Foggy.	1
Narrow field of view due to the monocular design.	1
Thermals are an advantage.	2

#### ENVG

Sweet.	1
Halo around the edges and thermals took a little long to come up.	1
My thermals were not working.	1
Thermal overlay has a distinct orange border around it, even on lowest setting.	1

5. During this trial did you use mainly I-squared, mainly thermal, or an equal mix of the two?

1 2 3 4 5 6 7  
100% Mostly Slightly Equal Slightly Mostly 100%  
I-Squared I-Squared I-Squared Mix Thermal Thermal Thermal

MEAN RESPONSE	
PVS14	ENVG
NA	4.60

#### AN/PVS-14

I was only able to engage the enemy about 15 meters ahead of me. Couldn't see them until they got up on me. 1  
It's hard to see the enemy because the 14 has no thermals. 1

#### ENVG

Both work well. 1  
Knob system is better than the button/scale system. 1  
Only the thermal could see through the brush and fog. 1  
The thermal picture had a "leak" to it. It seemed on the top right corner there was a thermal signature that was bright and stayed there, almost obstructing the sight picture. 1  
Thermals wouldn't come on at first, just had orange screen, had to turn it off several times for it to work. 1  
The battery pack falls off. 1

6. Did you experience any problems using the goggle during this trial? Check all that apply.

No. of Responses		
	PVS14	ENVG
Eye strain	17	22
Tunnel vision	5	10
Headaches	5	5
Motion sickness	0	0
Nausea	0	0
Disorientation	5	5
Dizziness	2	1
Lens fogging	29	23
Screen white-out	1	0

7. Did you experience any other problems with the goggles?

#### AN/PVS-14

Battery cap came loose. 1

**ENVG**

Frustration.	2
The thermal went crazy and started messing up.	1
The battery pack bracket needs to be better.	1

8. Using the scale below, rate your ability to perform the following tasks during the trial.

1	2	3	4	5	6	7
Extremely hard	Very hard	Hard	Neutral	Easy	Very easy	Extremely easy

TASKS:	MEAN RESPONSE	
	PVS14	ENVG
Scan sector	5.37	5.53
Identify terrain features	5.40	5.42
Move over rough ground	5.28	5.32
Move at a quick steady pace	5.32	5.39
Maintain visual contact with team members	5.39	5.53
Detect targets	5.05	5.58

## PATROL

SAMPLE SIZE = 114 (TWO DAYS)

1. Please rate the following using the scale below.

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
<b>Extremely bad</b>	<b>Very bad</b>	<b>Bad</b>	<b>Neutral</b>	<b>Good</b>	<b>Very good</b>	<b>Extremely good</b>

GOGGLE CONTROLS:	MEAN RESPONSE	
	PVS14	ENVG
Ease of understanding control function	5.73	5.69
Location of controls	5.65	5.62
Access to controls	5.63	5.62
Ease of activating controls	5.66	5.63
Ease of adjusting mix of thermal & I <sup>2</sup>	NA	5.52
Control settings were maintained during the trial	5.77	5.48

### Comments

### No. of Responses

#### AN/PVS-14

Controls stayed the same.	2
Controls work well.	2
Easy to focus.	1
Muscle memory.	1
Needs thermal.	2
Lacks distance.	1

#### ENVG

Like knobs.	2
Controls in good spot.	1
Easy to switch to thermal.	1
Good run.	1
As we ran, the goggles kept turning off. I had to move the swing arm up so they would turn on again, but they would turn off from the bouncing.	3
When the goggles were bumped the thermal screen would freeze up or reset.	1
Controls are too easy to be knocked around by brush.	1
The goggle weight is too much; needs to be more even front and back.	1
Trying to adjust between white hot and black hot is somewhat confusing.	1

GOGGLE MOUNTING:	MEAN RESPONSE	
	PVS14	ENVG
Ease of attaching mount to helmet	5.65	5.62
Ease of attaching goggle to helmet mount	5.60	5.57
Stability of helmet mount	5.50	5.55

Balance of goggle on helmet	5.47	5.47
Wearing comfort	5.36	5.28

## ENVG

Balanced nicely.	1
Blech!	1
Didn't balance well.	1
NVGs too big and hit the Kevlar so I can't place them on my eye.	1
Heavy on front.	3
Needs less weight, uncomfortable.	3
Mount fell off at end of movement.	1
Pulled Kevlar down several times.	1
Screw attachment stinks.	1
The mount slips too much.	1
The straps like to slip and loosen after continuous wear.	1

2. Please rate the following characteristics using the scale below.

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
<b>Extremely bad</b>	<b>Very bad</b>	<b>Bad</b>	<b>Neutral</b>	<b>Good</b>	<b>Very good</b>	<b>Extremely good</b>

CHARACTERISTICS:	MEAN RESPONSE	
	PVS14	ENVG
Weight of goggle	5.32	5.12
Shape of goggle	5.39	5.37
Adequacy of field of view	5.27	5.24
Ability to perceive depth	5.09	5.24
Sight picture brightness	5.44	5.31
Sight picture clarity	5.40	5.24
Color of thermal overlay	NA	5.31
Ease of eyepiece adjustment	5.50	5.53
Ease of stowing goggle in flip-up position	5.73	5.82
Once stowed, goggle maintains flip-up position	5.74	5.90
Overall ease of use	5.59	5.70

## AN/PVS-14

Best clarity.	3
Good goggles.	2
These goggles are lighter than the other two.	1
Needs thermal.	4
Snowy picture.	1

## ENVG

Crystal clear picture.	1
Good controls.	1
Great thermal.	1
I don't like the orange color for the thermal.	2
I'm getting annoyed now.	1
Picture really isn't that clear.	4
Picture was blurry.	4
The sight picture brightness wouldn't adjust very bright.	2
Depth perception not really good.	1
Weight makes it pull down on the goggle.	1
Wouldn't have seen them without thermals.	1

3. How good was your situational awareness – your knowledge of what was going on around you – during this trial?

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
<b>Extremely bad</b>	<b>Very bad</b>	<b>Bad</b>	<b>Neutral</b>	<b>Good</b>	<b>Very good</b>	<b>Extremely good</b>

MEAN RESPONSE	
PVS14	ENVG
5.23	5.49

## AN/PVS-14

I knew what was going on around me.	1
I could see everything but couldn't detect the ambush.	1
Lack of thermals made accurate target detection before engagement very difficult.	1
No thermals.	1
When you're on the move, they don't fog up, that's always a plus. But with this humidity and it just rained and all, a second standing still would fog the goggle all up.	1

## ENVG

I could see the enemy before I got to them.	1
I wasn't able to see the enemy ahead of time but I was quickly able to figure out where the fire was coming from.	1

4. What is your overall rating for the goggle you used for this trial?

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
<b>Extremely bad</b>	<b>Very bad</b>	<b>Bad</b>	<b>Neutral</b>	<b>Good</b>	<b>Very good</b>	<b>Extremely good</b>



MEAN RESPONSE	
PVS14	ENVG
5.16	5.36

#### AN/PVS-14

Overall these goggles work well. 2  
Thermals are an advantage. 1  
Everything without thermal capabilities is a total waste of money. 1  
Its hard to see through the brush. 1  
You can't see anyone, except maybe the guy in front of you and even then, he'd better not go too far. 1

#### ENVG

Sweet. 1  
Thermals helped a lot. 1  
It went pretty smooth. 1  
It was hard to perceive depth perception. 1  
Picture is a little snowy. 1  
The thermal went out. Just went out, out of the blue and wouldn't come back up. 1

5. During this trial did you use mainly I-squared, mainly thermal, or an equal mix of the two?

1 2 3 4 5 6 7  
100% Mostly Slightly I- Equal Mix Slightly Mostly 100%  
I-Squared I-Squared Squared Thermal Thermal Thermal

MEAN RESPONSE	
PVS14	ENVG
NA	4.62

#### AN/PVS-14

Needs thermal. 1  
The PVS-14s are very useful but not in a patrol. I couldn't identify the enemy until the engagement began. I'd say that the 14s are dangerous in night patrolling. 1

#### ENVG

Mix was good. 1  
The thermals were good for detecting people and the I<sup>2</sup> was good for seeing the terrain. 1  
The thermals help a lot. 1  
The knob system is very good. 1  
The depth perception with the thermals is a lot better because you have more control over the I<sup>2</sup>/Thermal ratio. 1  
The only problem I had with the goggle was that when you rotate the goggle up and pull it back down you have to reset the goggle. 1

# 1

1

No. of Responses		
	PVS14	ENVG
Eye strain	15	15
Tunnel vision	5	5
Headaches	7	4
Motion sickness	0	0
Nausea	0	0
Disorientation	2	2
Dizziness	2	2
Lens fogging	17	13
Screen white-out	9	0

**ENVG**

2

1

1

1	2	3	4	5	6	7
Extremely hard	Very hard	Hard	Neutral	Easy	Very easy	Extremely easy

120

## COMPATIBILITY

SAMPLE SIZE = A (62); B (63)

CLOTHING/EQUIPMENT: NBC Mask, SWD Goggles, and BLEP

1. Using the scale below, please rate your ability to perform the following tasks on the trials you just completed.

**1**                      **2**                      **3**                      **4**                      **5**                      **6**                      **7**  
**extremely hard**    **very hard**            **hard**                **neutral**            **easy**                **very easy**           **extremely easy**

### A. From Standing Position:

	MEAN RESPONSE					
	NBC		SWD		BLEP	
	PVS14	ENVG	PVS14	ENVG	PVS14	ENVG
Assuming the firing position	6.00	5.84	6.16	5.84	5.94	6.17
Manipulating goggle controls	5.71	5.53	6.12	5.76	5.94	5.72
Accessing magazine	6.00	5.61	6.25	5.84	5.76	6.19
Changing magazine	5.95	5.59	6.00	5.76	5.56	6.12
Pulling the charging handle	6.20	5.83	6.21	5.83	5.87	6.12
Obtaining the full field of view afforded by the goggle	5.52	4.47	5.52	4.84	5.94	5.61
Adequacy of field of view	5.05	4.16	5.48	4.68	5.82	5.61
Helmet mount balance	5.90	4.84	5.56	5.36	5.65	5.44
Overall ease of use	5.86	4.79	5.84	5.37	5.94	5.83

### NBC

#### AN/PVS-14

Easy to use. 1

The NODs were too close to the mask. 1

With the pro-mask on, the goggle is so far away from your face that you can only see directly in front of you. The picture is also smaller and you're disoriented for a second. 1

#### ENVG

Was easy to work with the weapon because we have used 14s so long that I knew where everything was. 1

Picture was unclear and blurry. 1

The goggle is too close to the mask when lowered. 1

FOV was real small and crummy. 1

Hard to see mount; wouldn't move enough to adjust to the pro mask. 1

It made the whole package a little heavy. If I had to wear that for more than 2 hours I would probably go nuts. 1

NODs could not lower all the way so the view was tilted up. 1

The goggles don't line up with the lenses on the mask so I could hardly see out of the goggles. 1

## SWD

### AN/PVS-14

Very good. 1  
 It was very easy to mount these goggles with the SWD goggles. 1  
 Alpha's are easy to use. 1  
 Very familiar with them. 1  
 Pretty good, though glasses pushed back NODs a little. 1  
 Heavy in front. 1  
 Little off balanced. 1  
 The goggle is too bulky and as a result it's hard to get the NVGs close to your face. 1  
 Very narrow field of view. 2  
 They restricted my field of view somewhat. 1  
 Took too long to get a good sight picture with these goggles on. 1

### ENVG

They don't fit over the goggles that were provided very well so it left me with a small field of view. 2  
 Could not see because of SWD goggles. 1  
 Didn't sit right. 1

## BLEP

### AN/PVS-14

Could see targets and perform tasks easily. 1  
 I can't see clearly at night with goggles on. 1

### ENVG

No comments.

## B. From Kneeling Position:

	MEAN RESPONSE					
	NBC		SWD		BLEP	
	PVS14	ENVG	PVS14	ENVG	PVS14	ENVG
Assuming the firing position	6.15	5.95	6.32	5.76	5.82	6.24
Manipulating goggle controls	6.10	5.79	6.24	5.76	5.94	6.12
Accessing magazine	6.16	5.83	6.12	5.71	5.75	6.19
Changing magazine	6.00	5.67	6.00	5.68	5.56	6.19
Pulling the charging handle	6.16	5.94	6.12	5.76	5.75	6.19
Obtaining the full field of view afforded by the goggle	4.90	4.68	5.92	5.00	5.76	5.76
Adequacy of field of view	4.80	4.32	5.64	4.96	5.88	5.53
Helmet mount balance	5.60	4.95	5.72	5.40	5.71	5.59
Overall ease of use	5.90	5.11	5.88	5.44	6.00	5.88

## **NBC**

### **AN/PVS-14**

Once I got the helmet back on the goggle seems like I shifted and I could only see a very small portion through the goggle. 1

### **ENVG**

It was ok kneeling. 1

The balance presented a small problem with the goggles on the Kevlar with NBC mask on. 1

FOV is small. 1

NODs were tilted because of mask. 1

Still had trouble lining up the goggles with the lenses of the mask. 1

## **SWD**

### **AN/PVS-14**

Very good. 2

It was easier to use these goggles than the others. 1

Feels like goggles need to be closer to eye to obtain a good sight picture. 1

Field of view is more restricted. 1

Heavy in front. 1

Lens started to fog up a little on that one. 1

### **ENVG**

Front heavy. 1

Still could not see very well through the goggles that I had on. 1

### **BLEP**

### **ENVG**

Good. 1

### **C. From Prone Position:**

	MEAN RESPONSE					
	NBC		SWD		BLEP	
	PVS14	ENVG	PVS14	ENVG	PVS14	ENVG
Assuming the firing position	6.00	5.74	6.24	5.52	5.76	6.24
Manipulating goggle controls	6.05	5.74	6.16	5.64	6.00	5.94
Accessing magazine	6.11	5.68	6.08	5.60	5.76	6.19
Changing magazine	5.72	5.63	6.12	5.56	5.59	6.19
Pulling the charging handle	6.21	6.00	6.24	5.64	5.76	6.25
Obtaining the full field of view afforded by the goggle	5.55	4.53	5.84	4.88	5.76	5.76
Adequacy of field of view	5.45	4.26	5.64	4.92	5.76	5.59
Helmet mount balance	6.00	4.74	5.68	5.28	5.76	5.65
Overall ease of use	6.05	5.06	6.08	5.52	6.00	5.82

## **NBC**

### **AN/PVS-14**

Changing magazines, accessing magazines, and pulling charging handle isn't affected by types of goggles. 1

When using the goggle, changing magazine, and pulling the charging handle, you can't see anything. 1

### **ENVG**

It was pretty easy and you could balance the goggles better. 1

Very difficult to see and adjust. 1

FOV is small. 1

Switched from left eye to right eye and could see a little better, but still didn't have a full view. 1

Mask causes NOD to tilt. 1

## **SWD**

### **AN/PVS-14**

Good sight, good everything. 1

I had no problem with the goggles. 1

Lens was fogged up at this point. 1

Restricted field of view with SWD goggles. 1

Takes a little effort to keep your head up looking at the target. 1

Weight is in front of helmet. 1

### **ENVG**

Still could not see a clear picture through the goggle that I had on. 1

## **BLEP**

### **ENVG**

Easy. 1

Usually being in the prone with B goggle is impossible, but this time they seemed to stay in place. 1

2. Using the scale below, please rate the following visual features based on the trial you just completed.

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
<b>extremely hard</b>	<b>very hard</b>	<b>hard</b>	<b>neutral</b>	<b>easy</b>	<b>very easy</b>	<b>extremely easy</b>

**A. FROM STANDING POSITION:**

	MEAN RESPONSE					
	NBC		SWD		BLEP	
	PVS14	ENVG	PVS14	ENVG	PVS14	ENVG
Sight picture clarity	5.75	4.42	5.36	4.68	5.71	5.65
Sight picture brightness	5.70	4.79	5.60	4.88	5.76	5.82

**NBC**

**AN/PVS-14**

Very clear. 1

**ENVG**

I could see my target clearly when asked to. 1

Blurry. 1

Clarity was blurry due to pro mask. 1

Mask was foggy so the picture was blurry. 1

Couldn't see. 1

The goggles don't line up with the lenses on the mask so I could hardly see out of the goggles. 1

**SWD**

**AN/PVS-14**

Excellent. 1

Very clear picture. 1

It was easier to see with these goggles also. 1

SWD goggles make it a little less clear, but can still disseminate images. 1

Fogged almost immediately after I put them on. 3

**ENVG**

The goggle had an orange tint to it without thermals. 2

The goggles were foggy which made the picture through the goggles fuzzy too. 1

Hard to fit goggles in front of SWD, making everything blurry. 1

**BLEP**

**AN/PVS-14**

I wear glasses and I don't have to have them on to see with the A goggles. 1

**ENVG**

Good to go. 1

Nicely balanced. 1

**B. FROM KNEELING POSITION:**

	MEAN RESPONSE					
	NBC		SWD		BLEP	
	PVS14	ENVG	PVS14	ENVG	PVS14	ENVG
Sight picture clarity	5.80	4.58	5.76	4.68	5.76	5.65
Sight picture brightness	5.70	4.79	5.84	5.00	5.82	5.76

**NBC**

**ENVG**

I could still see the target clearly with no problem. 1  
 It was better than standing. 1  
 Mask caused blurriness. 1

**SWD**

**AN/PVS-14**

I could still see clearly. 2  
 Glasses didn't fog as much. 1  
 Lens fogged up. 1  
 SWD limits my sight picture; it gets fuzzy. 1

**ENVG**

Picture was foggy. 2  
 Still orange yellowish picture on the bottom of the sight picture. 1

**BLEP**

**ENVG**

Clear. 1

**C. FROM PRONE POSITION:**

	MEAN RESPONSE					
	NBC		SWD		BLEP	
	PVS14	ENVG	PVS14	ENVG	PVS14	ENVG
Sight picture clarity	5.80	4.44	5.84	4.64	5.65	5.47
Sight picture brightness	5.75	4.74	5.92	4.80	5.71	5.88



**NBC****ENVG**

Bad run. 1

It was a lot better after you adjusted the goggles. 1

Mask causes blur. 1

**SWD****AN/PVS-14**

Good to go. 1

Best overall picture yet. 1

Great run. 1

I could see clearly and easily. 1

Lens fogged up. 2

**BLEP****AN/PVS-14**

With the clip it was very easy to take the goggle off. 1

Easy. 1

**ENVG**

Foggy picture. 1

Not a very clear picture. 2

Still yellow picture. 1

5. Using the scale below, please rate the following characteristics based on the trial you just completed.

1 2 3 4 5 6 7  
 extremely hard very hard hard neutral easy very easy extremely easy

	MEAN RESPONSE					
	NBC		SWD		BLEP	
	PVS14	ENVG	PVS14	ENVG	PVS14	ENVG
Donning	5.74	4.47	6.00	4.87	5.76	5.47
Doffing	5.95	5.05	6.08	5.09	6.00	5.76
Shape	5.79	5.05	6.04	5.30	5.41	5.41
Wearing comfort	5.47	4.74	5.92	4.91	5.29	5.06
Overall compatibility with clothing/equipment	5.53	4.00	5.54	4.39	5.75	5.40
Weight	5.89	4.95	5.83	5.17	5.24	5.06

## **NBC**

### **AN/PVS-14**

You have to position the NODs right. 1

### **ENVG**

Easy to do. 2

Easy to use and to put on. 1

Kind of tough trying to focus looking through the mask. 1

Battery pack was on backwards. 1

## **SWD**

### **AN/PVS-14**

Excellent. 1

They were very easy to use. 1

Very familiar with 14's. 1

Goggles worked well but took a while to don the goggles and get a good sight picture with the SWD goggles. 1

Good compatibility with SWD. 1

### **ENVG**

With SWD goggles, it seemed to be steadier. 1

Couldn't get a clear picture. 1

Hard time putting the goggles on. 1

Too heavy and the weight is not distributed evenly. 1

Too many parts. 1

## **BLEP**

### **AN/PVS-14**

Kevlar would not go on over the goggle. 1

### **ENVG**

Could see just fine, pretty clear. 1

Not an NBC mask, but very compatible with this piece of equipment. 1

The safety goggles impair my view. 1

## END-OF-TEST QUESTIONNAIRE RESULTS

1. Please answer the following questions that deal with your experience during MOUT Target Detection:

### a. Detecting targets in windows

#### **AN/PVS-14:**

Best I <sup>2</sup> .	3
Easy to use with the illumination.	1
Easy to see.	1
Good due to good clarity, which the other NVGs don't have.	2
Only needs thermals to be perfect, and to have some weight.	1
No thermal.	4
Was not always looking for heat signatures; was focused on targets.	1

#### **ENVG:**

B was best due to the thermals.	6
I just feel that B's are better.	1
Easiest to use.	1
Easy to understand, function and operate.	2
You could easily and quickly adjust your thermal intensity and according to whether the window is closed or not, you are really going to need to.	1
Clearest thermal plus I <sup>2</sup> picture when used at same time.	2
Comes down the focusing ability of the I <sup>2</sup> .	1
Easier to tell difference between I <sup>2</sup> and thermals. When you saw a target through the Bravo thermals, it jumped out at you.	1
Best because you could turn down either the thermal or I <sup>2</sup> .	1
Clear sight picture.	3
Easier to see.	1
Easier to detect targets.	1
Adjustments can be made fast.	1
Not so heavy.	2
Just wasn't good.	1
Hard time with focus.	1
Least clarity.	1
B goggles take too long in the overlap.	1
Had an orange outline around thermal display that was darker than rest of box, making detection a guessing game.	1

#### **GENERAL:**

If there is glass, thermal will not see in.	2
With thermals, you can't miss seeing what's there.	1

## b. Detecting targets in doorways

### AN/PVS-14:

Easy to see.	3
Good, just need thermals.	2
No illumination, hard to ID targets.	1
Has better I <sup>2</sup> picture.	2
With just I <sup>2</sup> you could see in the doorway while moving without the thermal.	1
Worse because it had no thermal function.	2
Cannot see in a doorway if the background is pitch black.	1

### ENVG:

Best thermal.	2
Easy to understand, function, and operate.	1
Thermals helped a lot.	7
Easier to tell difference between I <sup>2</sup> and thermals. When you saw a target through the Bravo thermals, it jumped out at you.	1
Best because of it's weight.	1
Could see them at close range but not at great distance.	1
The ability to adjust the sight picture either thermal or night sight is nice.	1
Easier to use.	2
With the thermals being halfway on the screen, you could get a good silhouette.	1
Easier to see with goggle B.	1
Overall better picture.	1
Thermal made identifying window targets quicker.	1
Clearest thermal plus I <sup>2</sup> picture when used at same time.	1
Best because you could turn down either the thermal or I <sup>2</sup> .	1
Had just enough thermal to see a target in the door.	1
B Goggles had best focusing ability and ease of controls.	1
Easier to detect targets.	1
Fast adjusting.	1
B goggles take too long in the overlay.	1
Least clarity.	1
Had an orange outline around thermal display that was darker than rest of box, making detection a guessing game.	1

## c. Scanning buildings for targets

### AN/PVS-14:

Easy to see.	1
Best for scanning building.	1
Best I <sup>2</sup> picture.	2
Did not have much of a problem picking up targets in rooms.	1
Allowed more vision and were clearer.	1
Worse because it had no thermal function.	2
No illumination, hard to ID targets.	1

**ENVG:**

Easiest to see with goggle B.	1
The thermals are better.	5
Good view.	1
Easier to tell difference between I <sup>2</sup> and thermals. When you saw a target through the Bravo thermals, it jumped out at you.	1
Great zoom.	1
Easy to understand, function, and operate.	1
Weight.	1
The ability to adjust the sight picture either thermal or night sight is nice.	1
Easiest to use.	1
Being able to adjust the brightness of the thermal and I <sup>2</sup> gives you the greatest advantage.	1
Overall better picture.	2
Thermal made identifying window targets quicker.	1
Clearest thermal plus I <sup>2</sup> picture when used at same time.	1
Made targets in the building stick out more.	1
Easiest to see when scanning.	2
Thermal and clarity allow you to see deep into the rooms.	1
Easier to detect.	1
Good for quick adjustment to brightness.	1
Could not pick up targets in rooms.	1
I <sup>2</sup> was not bright enough and clear enough.	1
Moving with thermals causes the ghost effect.	1
Had an orange outline around thermal display that was darker than rest of box, making detection a guessing game.	1
Hotter on the left rather than the right.	1

**GENERAL:**

The thermals really help if you're not behind glass.	1
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2. Please answer the following questions that deal with your experience during Land Navigation:

**a. Navigating the terrain****AN/PVS-14:**

Best.	1
Easy to see.	2
Easier to see when walking around; in woods, too.	2
I felt the least disoriented.	1
Best picture quality.	9
Best picture when doing land navigation.	1
Easy to determine the terrain.	1
Chose A because I was used to using them from previous land navigation courses.	1
Easiest goggle to use.	1
Best I <sup>2</sup> , even to read close up.	4
Better depth perception.	4
No need for thermal detection.	1
Better field of view.	3

Bad depth perception.	1
Chose A goggle as #2 because it was simple and you did not have to use both hands just to adjust your sight picture.	1
A goggle was best because you do not need thermal for land navigation.	1
A goggles worked just fine; there was no need for thermals.	1
Could focus to a much better detail.	1

#### **ENVG:**

Nice and clear sight picture; sharper image.	2
Good depth perception.	1
Easy because of thermal and better field of view.	1
More stable on head mounts, which made it easier to see while traveling over rough terrain.	1
More likely to go out and hinder your actions.	1
Thermals get in the way.	2
Wouldn't keep the adjustment.	1

#### **GENERAL:**

Go with what you know.	1
Couldn't really see any for good depth perception.	1
All three without thermal overlay.	1
They were all about the same.	2
The thermal addition didn't help much.	1
Easier to navigate with I <sup>2</sup> because thermals only provide an advantage in pitch black.	1

#### **b. Reading the map accurately**

#### **AN/PVS-14:**

Good.	1
Easy to see.	4
Easy because I'm used to it.	1
Good zoom.	1
Could only see the map with the A.	8
Best picture quality.	5
Can see better at close distances.	1
Best I <sup>2</sup> , even to read close up.	1
Better focus.	1
Easy to read with the A goggles.	1
Had lens cover with holes that allowed for focusing.	1
Better field of view.	1
The daytime sight makes the difference.	1
Easier to focus goggle A.	3
Just barely read the numbers with the A goggles.	1
Could not see the map at all.	1
Fogged up too easily.	1
More likely to go out and hinder your actions.	1
I could read the map but not very clearly.	1

**ENVG:**

Easy because of thermal and better field of view.	1
Easy to read a map with.	3
Clear.	1
Had lens cover with holes that allowed for focusing.	2
Easily readable with lens cap on; worked great.	3
Easy to adjust.	1
Easier to focus goggle A.	1
Zoomed in easily.	1
Could not read map with goggle B.	3

**GENERAL:**

It was hard to see the map with any of them.	7
All the same.	1

**c. Depth perception****AN/PVS-14:**

Easy to see.	1
Easier to navigate with.	1
Best illumination picture.	1
Clear picture.	4
Could adjust focus better.	1
Best depth perception.	5
Best night vision.	1
Thermals affect depth perception.	1
Least amount of eye strain.	1
Better with A goggles.	1
Only goggle I could see the map with.	1
Had the ability to focus at all ranges.	1
Used to using the A goggles in that situation.	1
I <sup>2</sup> was better.	1
Not as blurry.	1

**ENVG:**

Best one of all.	1
Good depth perception.	1
I <sup>2</sup> was better.	2
I could move across the ground the fastest.	1
Thermals made up for what the A goggles hand in I <sup>2</sup> .	1
Made it seem as if there were a great difference in range.	1
B goggles were the worst.	1
Had most problems with B goggles.	1

**GENERAL:**

They all stunk.	1
All three without thermal overlay.	1
Depth perception really isn't good on any of them.	1

They were all about the same.	5
Goggles A and B were about the same.	1

3. Please answer the following questions that deal with your experience during Woodland IMT:

a. Going under obstacles

**AN/PVS-14:**

Good.	1
Very accurate in I <sup>2</sup> .	2
Easy to see.	1
Easy to use.	1
Best illumination picture.	1
Best depth perception.	2
Easy to maneuver.	2
Good balance.	1
Lightest weight and least bulky.	7
You could determine the height of an object better.	1

**ENVG:**

Clearer picture.	2
Good I <sup>2</sup> .	1
Easy mount.	1
Good balance.	1
Easy to move with.	1
Did not get caught up in obstacles.	1
Thermal overlay didn't effect as much.	1
Because of depth perception and field of view.	2
Came unfocused too much.	1
Couldn't see that well.	1
They went out too much blocking out the I <sup>2</sup> .	1

**GENERAL:**

All had same basic shape, size, and height, as well as depth perception.	1
You tap the thermals wiring, they malfunction.	1
I didn't have a favorite.	2
If adjusted right by switching to near would help in the obstacles.	1

b. Going over obstacles

**AN/PVS-14:**

Easy to see.	1
Very accurate in I <sup>2</sup> .	1
Good clarity that the other two lack.	1
Easy to use.	1
Best illumination picture.	1
Best depth perception.	5
Less weight.	4



Good balance.	1
Easy to maneuver.	1

**ENVG:**

Because of depth perception and field of view.	2
Steady and stable.	2
Clarity.	1
Good I <sup>2</sup> .	1
You could see and judge better with these goggles.	1
Thermal overlay didn't effect as much.	1

**GENERAL:**

Thermals are hard to run with.	1
All had same basic shape, size, and height, as well as depth perception.	1
Did not matter.	1
None provided any better vision than the other.	1

**c. Going through obstacles**

**AN/PVS-14:**

Easy to see.	2
Easy to use.	1
Best illumination picture.	1
Less weight; bulk.	5
Best depth perception and field of view.	3
I'm used to them, so I can navigate better.	1
Easy to maneuver.	1
Less bulk.	1

**ENVG:**

Good I <sup>2</sup> .	1
Depth perception and field of view.	3
Small and compact.	1
Thermal overlay didn't effect as much.	1
Even though the thermal would act up, it was very helpful.	1
Shut off and bounced around a lot.	1
Too close to the face, which made it difficult to keep the NODs out of the dirt.	1

**GENERAL:**

Thermals are hard to run with.	1
All had same basic shape, size, and height, as well as depth perception.	1

**d. Scanning for targets**

**AN/PVS-14:**

Because of depth perception and field of view.	1
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**ENVG:**

Ideal for this.	2
Clear picture.	1
Depth perception and field of view.	3
More stable.	1
The thermal image could detect heat images better than A.	1
Because of thermals.	2
Thermals worked better than outline.	1
Identify targets the quickest and fastest.	2
Thermal outline hurt – clouding thermal with bright orange.	1

**e. Detecting targets****AN/PVS-14:**

Because of depth perception and field of view.	1
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**ENVG:**

Depth perception and field of view.	4
Easy.	1
The thermal image could detect heat images better than A.	1
The B's are good.	1
Because of thermals.	4
Identify targets the quickest and fastest.	1
More stable.	1
The thermals are brighter and the targets stood out more.	1
Thermal outline hurt – clouding thermal with bright orange.	1

**f. Navigating the course at a quick pace****AN/PVS-14:**

Easiest.	1
Simplest to navigate course with.	1
Easy to see.	1
I <sup>2</sup> accurate.	2
Bright and clear.	1
Illumination picture is better.	1
Maintain focus better and have better vision.	1
Less weight.	3
Good balance.	1
Easier to move with.	2
Because of depth perception and field of view.	1
I'm just used to it.	2
Better because it didn't have the thermal outline.	1

**ENVG:**

Depth perception and field of view.	4
Stable and easy to use.	3
Weight.	1

Adjusting knobs can be easily switched.	1
Shut off and the thermals got in way of the IR.	1
Wouldn't keep settings.	1

**GENERAL:**

Go with what you know.	1
Did not matter.	1

4. Please answer the following questions that deal with your experience during MOUT Defend and Attack:

a. Approaching building in a stealth mode

**AN/PVS-14:**

Great I <sup>2</sup> .	2
I'm just used to using these.	1
Couldn't see through smoke.	1
Could not approach building very well with A goggles.	1

**ENVG:**

Can see through smoke.	7
The lighter it is, the easier to move.	1
Best depth perception.	1
Could easily identify enemy from distance.	1
Easier to see building structure.	1
Clarity plus the ability to see the thermal target made the best combo.	1
Great thermals.	3
Overall was clearest and had thermal technology.	1
Thermals were better because you could follow your team better and detect the enemy better.	2
Had poor clarity.	1
Had worst picture and depth perception.	1

**GENERAL:**

OK.	1
We didn't approach building in stealth, we had a full on charge.	2
What stealth?	2

b. Detecting targets in windows

**AN/PVS-14:**

Clear image to distinguish between building and target.	1
Goggle A was better than goggle B in I <sup>2</sup> .	1

**ENVG:**

Good.	1
Has thermals; makes them better.	8
Thermals help to find the targets even with smoke.	3
Thermal made it easy to see personnel.	2

Better at detecting thermal targets.	1
Heat signature better because of thermals.	1
The adjusting knobs help during a quick change in a sight picture.	1
Being able to adjust the thermal and I <sup>2</sup> mix accordingly is very good.	1
Clearest picture.	4
Thermal outline hurt – clouding thermal with bright orange.	1

**GENERAL:**

Thermals came through when there wasn't any glass.	1
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**c. Detecting targets in doorways**

**AN/PVS-14:**

Clear image to distinguish between building and target.	1
Worked the best inside.	1
Could see well with the A goggles.	1
Goggle A was better than goggle B in I <sup>2</sup> .	1

**ENVG:**

Easy.	1
Has thermals, which make them better.	11
Thermals help to find the targets even with smoke.	3
Better at detecting thermal targets.	1
Adjusting knobs.	1
I <sup>2</sup> picture was better for civilian targets.	1
Being able to adjust quickly.	1
Clearest picture.	1
Thermal outline hurt – clouding thermal with bright orange.	1

**GENERAL:**

Thermals were very useful.	1
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**d. Recognizing civilians in buildings**

**AN/PVS-14:**

Clear at close range.	1
Didn't have thermal in the way.	2
Could recognize weapon discrimination.	1
Better outline of targets made identification easier.	1
I <sup>2</sup> worked best in identifying civilians	1
Had better picture.	2
Easier to see with A goggles.	1
Goggle A was better than goggle B in I <sup>2</sup> .	1
With smoke in the building, made it hard to tell if friend or foe.	1

**ENVG:**

Has thermals, which make them better.	3
Thermals help to find the targets even with smoke.	1

Thermal made it easy to see the helmets and gear on personnel.	1
Better at detecting thermal targets.	1
I could tell that the civilians were not wearing Kevlar's.	1
The thermal helped distinguish the difference in clothing.	1
Had more detail through the thermal.	1
From a distance, the thermals helped ID the stance of the civilians on the battlefield (COBs).	1
The picture was clear, easier to identify.	2
Thermal image gets in the way.	1

**GENERAL:**

Difficult with all.	2
No such thing as a COB.	1
I never went into a building.	1

**e. Clearing rooms**

**AN/PVS-14:**

I'm just used to A.	1
You could turn the NODs part up faster when you got into the room.	1
Best because they gave the best situational awareness.	1
Easier with I <sup>2</sup> .	1
Best for clarity.	1

**ENVG:**

Has thermals.	2
Thermals help to find the targets even with smoke.	1
Felt more comfortable with them.	1
Worked better at close ranges.	1
The simple adjusting knobs.	1
B goggles had good thermal and I <sup>2</sup> capabilities.	2
Less blur with B goggles.	1
See enemy a lot clearer with thermal.	1
Image delay occurs when moving with thermals.	1
You could turn the NODs part up faster when you got into the room.	1
Had the clearest picture while still having good thermal to make the targets a beacon.	2
Had more detail through the thermal.	1
You could quickly ID targets with thermals.	1
Narrow field of vision hindered goggle B.	1
Take too long to adjust that close.	1
Heat on room wall messed with the thermal.	1
Blurry in close quarters.	1

**GENERAL:**

The thermals made it hard while moving.	1
The thermals helped a little, but not enough to choose the best one.	1
I didn't clear any rooms.	1

5. Please answer the following questions that deal with your experience during Night Qualification:

a. Detecting targets 50-100 meters down range

**AN/PVS-14:**

Best goggles.	1
I <sup>2</sup> was clear and could see targets farther if they weren't thermal.	1
Targets easier to see without thermal overlay.	2
Everything seemed clear and bright.	1
Clearer picture up close.	1
I could tell targets went up.	1
Clarity of I <sup>2</sup> .	2
A goggles had a better picture.	1
Worst because they fogged up quickly.	1
Did not see a single target with them.	1
Could only see the 50-m target with A.	1

**ENVG:**

Great with short range targets.	1
Had a steadier hold.	1
Helped in seeing targets quicker.	1
B goggles were the best in this.	1
B goggles had the clearest thermal images.	2
Thermals pick up targets really good.	1
Poor clarity.	2
Kept seeing two of my own laser.	1
The thermal kept flickering.	1

**GENERAL:**

Did not have thermal targets so I had to use IR.	1
The same.	2

b. Engaging targets from foxhole 50-100 meters down range

**AN/PVS-14:**

I <sup>2</sup> very clear.	2
Targets were easier to see without thermal overlay.	2
Best target picture.	2
Clarity of I <sup>2</sup> .	1
Best goggles.	1
Worst because they fogged up quickly.	1
A thermal lag.	1
Could only see the 50-m target with A.	1

**ENVG:**

Easy to set the laser on the target.	1
Had a better mount.	1

B goggles were the best in this.	1
B goggles had the clearest thermal images.	2
Thermals pick up targets really good.	1
Kept seeing two of my won laser.	1
Ghosted causing two different targets.	1
Poor clarity.	1

**GENERAL:**

All the same.	1
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**c. Engaging targets from prone 50 to 100 meters down range**

**AN/PVS-14:**

The weight.	1
Targets were easier to see without thermal overlay.	1
Best target picture.	2
Clarity of I <sup>2</sup> .	3
Best goggles.	1
Could only see the 50 m with A.	1
Worst because they fogged up quickly.	1

**ENVG:**

Less weight of the goggles kept them from falling down.	1
Easy to see the targets with the thermals.	3
Had a clear picture and helped out a lot.	1
Ghosted causing two different targets.	1
Poor clarity.	1

**GENERAL:**

Did not have thermal targets so I had to use IR.	1
Thermal did not mess me up.	1
All the same.	1

**d. Knowing you hit a target 50 to 100 meters down range**

**AN/PVS-14:**

Easier to see.	1
Targets were easier to see without thermal overlay.	1
At that distance you do not need thermal.	1
Best target picture.	2
Clarity of I <sup>2</sup> .	3
Could only see the 50 m with A.	1
Best goggles.	1

**ENVG:**

Easy to identify.	2
Clear picture.	1
Target movement showed up more intensely on the image.	1

Good thermal overlay.	1
Easy to see the targets with the thermals.	1
Easier to see all targets from any position with thermals.	1
Ghosted causing two different targets.	1
Poor clarity.	1
Could not tell if I hit it; just that it went up and down.	1
You couldn't tell because the thermal image stayed for a second. Delayed reaction.	1

**GENERAL:**

Don't know; not borelighted.	1
Did not have thermal targets so I had to use IR.	1
Thermal did not mess me up.	1
All the same.	1
I'm not sure if I hit any.	1

**e. Detecting targets 150 to 250 meters down range**

**AN/PVS-14:**

Best goggles.	1
No thermal and fogged up.	2
Couldn't see past 150m.	1
Could not see with the A.	1

**ENVG:**

As range increased targets were easier to see.	1
Best thermal capabilities.	3
Thermals made the targets stand out.	1
The outline of the target was very defined.	1
Clear picture.	1
Saw the heat signature.	1
You could pick them up with the thermals.	1
Goggle B was better than goggle A if the target was thermal.	1
Easier to see all targets from any position with thermals.	1
Took too long to adjust.	1
Had worst picture and less on thermals.	1
Could not see the targets without the thermals.	1
Could not see targets, only offset heat signature.	1
Targets hard to identify even with thermals because overlay was off target.	1
Could hardly see them with the B.	1

**f. Engaging targets from foxhole 150 to 250 meters down range**

**AN/PVS-14:**

Best goggles.	1
I <sup>2</sup> picture was clear; could see targets easily.	2
No thermal and fogged up.	2
No thermal to give me two dimensions.	1



Thermals not good for engaging.	2
Couldn't see past 150m.	1

**ENVG:**

As range increased targets were easier to see.	1
Best thermal capabilities.	3
Clear picture.	1
You could pick them up with the thermals.	2
Goggle B was better than goggle A if the target was thermal.	1
Thermals washed out and ghosted targets.	1
Took too long to adjust.	1
Could not engage targets.	1
Could not see the targets without the thermals.	1
Targets hard to identify even with thermals because overlay was off target.	1
The thermal didn't seem to be where its I <sup>2</sup> image was.	1

g. Engaging targets from prone 150 to 250 meters down range

**AN/PVS-14:**

Best goggles.	1
I <sup>2</sup> picture was clear; could see targets easily.	2
No thermal and fogged up.	2
Hard to see the laser on the targets.	1
No thermal to give me two dimensions.	1
Thermals not good for engaging.	2
Couldn't see past 150 m.	1

**ENVG:**

Targets hard to identify even with thermals because overlay was off target.	1
Less weight of the goggles kept them from falling down.	1
Best thermal capabilities.	4
Clear picture.	1
Goggle B was better than goggle A if the target was thermal.	1
Thermals washed out and ghosted targets.	1
Took too long to adjust.	1
Could not engage targets.	1
Could not see the targets without the thermals.	1

**GENERAL:**

It was hard to be in the prone and look up far enough to see the targets through the NODs.	1
--	---

h. Knowing you hit a target 150 to 250 meters down range

**AN/PVS-14:**

Best goggles.	1
Could clearly see the targets go down with the A goggles.	1
Clarity of the I <sup>2</sup> .	1
No thermal and fogged up.	2

Hard to see the laser on the targets.	1
Couldn't see past 150m.	1

**ENVG:**

Target movement showed up more intensely on the image.	1
Best thermal capabilities.	1
Clear picture.	1
You could see the heat drop.	1
Goggle B was better than goggle A if the target was thermal.	1
You could see it go down with thermals.	1
Took too long to adjust.	1
Targets hard to identify even with thermals because overlay was off target.	1
Could not see the targets without the thermals.	1
Had delayed reaction to the target.	1

**GENERAL:**

Not sure; weapon and laser not bore sighted.	1
Not sure if I hit any.	1

**i. Mounting the goggles while wearing the protective mask**

**AN/PVS-14:**

Easy and light.	2
Quick/simple to mount.	4
Easier with strap on.	1
I have more experience with this one.	7
Easy because it had battery packs.	1
A goggles were better.	1
It was a simple click.	3
Easiest with the pro mask.	1
More compatible.	1
Slide and lock mechanism made for easier assembly.	1

**ENVG:**

Wider range of adjustments.	1
Pushes forward allowing a good sight picture.	1
Slide and lock mechanism made for easier assembly.	1
Little screws are bad.	1
Battery pack tough, but all tests were easy enough.	1

**GENERAL:**

All were equally easy.	3
All were hard to do.	1

**j. Mounting the goggles while wearing the BLEPS**

**AN/PVS-14:**

Easiest.	6
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Light.	1
Quick/simple to mount.	3
Nothing beats the simplicity.	1
Only have one piece to mount.	1
Did very little to hinder any of the tasks.	1
I'm used to them.	5
Mounting system was not as complicated as goggle B.	1
Pushes forward allowing a good sight picture.	1
Slide and lock mechanism made for easier assembly.	1
It connects in a simple fashion.	1
Had to turn a small knob or carefully align the NODs.	1

**ENVG:**

Hard.	3
Pushes forward allowing a good sight picture.	1
Slide and lock mechanism made for easier assembly.	1
Battery pack tough, but all tests were easy enough.	1

**GENERAL:**

All were fairly easy.	3
BLEPS were too small to matter.	1

**k. Mounting the goggles while wearing the SWD goggles**

**AN/PVS-14:**

Easiest.	8
Small; less bulk.	2
Quick/simple to mount.	3
Nothing beats the simplicity.	1
The simplicity of just a click goes a long way when you are tired and exhausted.	1
I'm used to them.	3
Did very little to hinder any of the tasks.	1
Easy because of battery pack.	1
Slide and lock mechanism made for easier assembly.	1
It connects in a simple fashion.	1
Hard to focus with the SWD.	1

**ENVG:**

Pushes forward allowing a good sight picture.	1
Slide and lock mechanism made for easier assembly.	1
Battery pack tough, but all tests were easy enough.	1
Wire was a pain if it comes undone.	1

**GENERAL:**

All were fairly easy.	3
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### l. Dismounting the goggles while wearing the protective mask

#### **AN/PVS-14:**

Easy.	7
Lightweight.	3
Quick/simple to mount.	3
I'm used to them.	7
Swing arm, flip mount.	1
Slide and lock mechanism made for easier assembly.	2
One button removed the goggles.	2
Less to mess with on the A goggles.	1
Less parts.	1
No wires to get in the way.	1
Took too long.	1

#### **ENVG:**

Slide and lock mechanism made for easier assembly.	1
Took too long.	1
It will take time to get used to these goggles.	1
Complex mounts.	1
B's slide off head mount.	1
Battery pack tough.	2

#### **GENERAL:**

I didn't have a favorite.	1
All were equally easy.	2

### m. Dismounting the goggles while wearing the BLEPS

#### **AN/PVS-14:**

A's flip mount, swing arm.	1
Easier.	7
Quick/simple to mount.	3
Lightweight.	2
Battery pack.	1
I'm used to them.	6
Less parts.	1
Did very little to hinder any of the tasks.	1
Slide and lock mechanism made for easier assembly.	2
The simplicity of just a click goes a long way when you are tired and exhausted.	2
You already knew what to do – it was just a reaction.	1
No wires to get in the way.	1

#### **ENVG:**

Slide and lock mechanism made for easier assembly.	1
Screw was stupid.	1
It will take time to get used to these goggles.	1
Complex mounts.	1

B's slide off head mount.	1
Battery pack tough, but all tests were easy enough.	1

**GENERAL:**

All were equally easy.	3
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**n. Dismounting the goggles while wearing the SWD goggles**

**AN/PVS-14:**

A's flip mount, swing arm.	1
Quick/simple to mount.	2
Easy to take off.	1
The best.	1
Easiest.	7
Lightweight.	2
I'm used to them.	6
Less parts.	1
Did little to hinder any of the tasks.	1
Battery pack.	1
Slide and lock mechanism made for easier assembly.	2
The simplicity of just a click goes a long way when you are tired and exhausted.	2
No wires to get in the way.	1

**ENVG:**

B's slide off head mount.	1
Slide and lock mechanism made for easier assembly.	1
Hard because remembering how to dismount the goggles.	1
Screw was stupid.	1
It will take time to get used to these goggles.	1
Complex mounts.	1
Battery pack tough, but all tests were easy enough.	1

**GENERAL:**

All equal.	1
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**o. Assuming kneeling firing position**

**AN/PVS-14:**

Easiest.	2
Lightweight.	6
Clarity.	1
Balance.	1
Less bulky.	1
I'm used to them.	2
Goggles did not affect this task.	1
I was not worried about losing the battery pack or breaking a small pin or cutting the wire in the process.	1
Because they did not move around as much when I assumed the position.	1

**ENVG:**

Thermals.	1
Too heavy.	1
Battery pack tough, but all tests were easy enough.	1

**GENERAL:**

No problems.	1
All easy to get into firing position.	1
All were equally easy.	7
Did not matter.	6
No real preference.	2
Not dependent on goggles.	3

**p. Assuming sitting firing position****AN/PVS-14:**

The best.	1
Easy to use.	1
Lightweight.	3
Less bulky.	1
I'm used to them.	2
I was not worried about losing the battery pack or breaking a small pin or cutting the wire in the process.	1
Because they did not move around as much when I assumed the position.	1

**ENVG:**

Good zoom.	1
Too heavy.	1
Battery pack tough, but all tests were easy enough.	1

**GENERAL:**

No problems.	1
All were equally easy.	7
All easy to get into firing position.	1
No difference.	1
Did not matter.	5
Not dependent on goggles.	3

**q. Assuming prone firing position****AN/PVS-14:**

Have little knobs (flat), much easier.	1
Easy to use.	1
Lightweight.	4
Less bulky.	1
I'm used to them.	2
Goggles did not affect this task.	1

I was not worried about losing the battery pack or breaking a small pin or cutting the wire in the process.	1
Because they did not move around as much when I assumed the position.	1
Just muscle memory from doing it.	1

**ENVG:**

Have little knobs (flat), much easier.	1
Clear and light.	1
Too heavy.	1
Stupid screw.	1
Had to be pushed into a good position.	1
Very difficult to see with the B goggles.	1
Battery pack tough, but all tests were easy enough.	1

**GENERAL:**

All easy.	5
All easy to get into firing position.	1
No problems.	7
Not dependent on goggles.	3

6. Please answer the following questions that deal with your experience during the Ambush phase:

a. Detecting targets

**AN/PVS-14:**

Field of view.	1
Good, due to good clarity.	2
I <sup>2</sup> is great.	1

**ENVG:**

Easy.	1
Good, due to thermals.	9
Targets stand out better with Bs.	1
Perfect mix of thermal and I <sup>2</sup> allowed detection from far away.	1
When adjusted right, you could see the target and the way they faced.	1
Could only see the targets with the thermals.	1
Thermals helped in the woods.	1
Clarity of the image is great.	1
You could see the heat.	1
B goggles are better – no pre-sets.	1
Could not see anything with B goggles.	1
Didn't like the thermal overlay. It hurt them in this test.	1

**GENERAL:**

No problems.	1
Thermals really help; thermal delay doesn't.	1

## b. Recognizing targets

### **AN/PVS-14:**

Field of view.	1
Had the best picture clarity.	2
I <sup>2</sup> is great.	2

### **ENVG:**

Easy.	1
Zoom.	1
Good because of thermals.	5
Detail of thermals is great.	2
Perfect mix of thermal and I <sup>2</sup> allowed detection from far away.	1
When adjusted right, you could see the target and the way they faced.	1
Thermals helped in the woods.	1
You could see the heat.	1
Thermals helped detect targets.	4
B goggles are better – no pre sets.	1
Could not see anything with B goggles.	1
The thermal blurred the I <sup>2</sup> .	1
Didn't like the thermal overlay. It hurt them in this test.	1

### **GENERAL:**

Easy with the thermal, hard without.	1
No problems.	1

## c. Engaging targets

### **AN/PVS-14:**

Field of view.	1
Lighter.	1
Nothing complex.	1
Clear.	1
Focuses faster.	1
I <sup>2</sup> is great.	2

### **ENVG:**

Easy.	1
Thermals are great.	2
Perfect mix of thermal and I <sup>2</sup> allowed detection from far away.	1
When adjusted right, you could see the target and the way they faced.	1
Thermals helped in the woods.	1
Had the best picture with the thermals.	1
Clarity of the image is great.	1
You could see the heat.	1
Thermals helped detect targets.	4
B goggles are better – no pre sets.	1
Could not see anything with B goggles.	1



Didn't like the thermal overlay. It hurt them in this test.	1
No easy to use in the prone.	1

**GENERAL:**

No problems.	1
Thermals best way to detect targets.	1
All the same once you engage, because you know they're there.	1
All three with PEQ-2 without thermal overlay.	1
No goggle made engaging targets easier.	1

7. Which goggle had better helmet mount design?

**AN/PVS-14:**

The guy that invented these is a genius.	1
Lightest of all.	2
Simplicity is the key.	4
Quick and simple to mount.	4
Easiest.	5
Stability.	1
Quick.	1
No wires; connections.	3
A's one flip mount.	1
Not stable enough as long as the wire from the battery box to mount is not part of the end product.	1
I am used to using that type of design.	1
Easiest and best helmet mount.	1
A goggle had the better battery box.	1

**ENVG:**

Good.	2
I liked how they could be angled to your eye.	1
Easier to attach.	1
Less to mess with; less to break.	1
Wire on B goggles was unobtrusive.	1
Really helped with target detection.	1
Had a mount for the Mitch helmet.	1
I like they way it mounted.	1
Had no screws.	1
Could adjust to your eyes better.	1
Worst because it would not guarantee a snap-fit all the time.	1
Harder to change in the dark.	1
Wires and battery box make it hard.	2
The "U" shaped mount was funky and seemed weak.	1
Not easy.	1
Too close to the face.	1

**GENERAL:**

Nothing to worry about but the goggles.	1
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Easy to turn and shoot.	1
The thermals had their pros and cons.	1

8. Which goggle had better battery box design?

**AN/PVS-14:**

The guy that invented these is a genius.	1
With A, battery pack is right there with the goggles.	1
Because it's still located on the nod.	1
Ease of operation is great.	2
Little chance of it falling out or off.	1
Quick.	1
Simple and compact design.	2
Better design.	1
Less components.	1
Internal is best.	2
Designed more for traveling through thick bush.	1
Batteries cannot come off.	1
Not have to worry about losing the battery box.	2
Had no battery box, which is good.	5

**ENVG:**

Easy access.	1
Goggles battery cord was easier to use.	1
Easier to open and less likely to have lid detached.	1
Nods have a basic design anyone can understand.	1
Smaller battery box.	2
Less chance of falling off.	1
I liked the drop down thing.	1
Easier to get on and off.	2
Better cable design.	1
Battery was knocked off twice during testing.	1
Battery box came off too easily.	2
Easy to lose.	1
Battery box broke.	1
Had too long of a wire.	1
Batteries hard to come off.	1
I had trouble lining grooves up while wearing K-pot.	1

**GENERAL:**

They were about the same.	2
There was not one that was that good.	1

9. Which goggles had better control knob design?

**AN/PVS-14:**

The guy that invented these is a genius.	1
The best.	1

Easy to reach.	1
One knob for all functions.	3
Knobs are better.	2
Large knobs are more recognizable and easier to operate.	1
Knobs more field expedient.	1
One click turn.	1
Everything was very simple.	4

**ENVG:**

Easy to adjust.	1
Too easy to push in.	1
Easier to use (than buttons).	5
Knobs worked best.	1
Knobs were easily accessible.	2
Simple and could access with gloves.	1
The knobs on the B goggles were familiar.	1
A lot simpler.	1
Gets adjusted by accident too much.	3
Better feel.	1
It is easier to disrupt the knobs when moving through brush.	1

10. Which goggle had the better design features (e.g., eyecup, weight, bulky, etc.)?

**AN/PVS-14:**

The guy that invented these is a genius.	1
The best.	1
A was easier because buttons are on bottom side.	1
Easy to reach.	1
Easy to work and understand.	1
Simple (and easy).	4
One click turn.	1
Best weight and size.	7
Everything is up front.	1
Eyecup was most secure.	1

**ENVG:**

Easy to work and understand.	3
Easy to adjust.	2
Easier to use.	1
Easy access.	1
Adjusted when hit right.	1
Too easy to push in.	1
Buttons worked better on B.	1
While it weighed more, it was easier to move through obstacles.	1
Weight and size were great.	3
More compact.	1
Best even though they look plain and not so high-tech.	1
Not so many functions to memorize.	1

Had almost the same design as the A goggles.	1
I like the ability to more accurately control thermal to I <sup>2</sup> ratio.	1
Better I <sup>2</sup> .	1
Simple design.	1
Thermal is preferred.	1
Good controls.	1
Fogged up more than the others.	1

**GENERAL:**

Weight was never an issue.	1
None of these features really mattered.	1
All were equal.	2

11. If you could take any of the goggles to combat, which would it be?

**AN/PVS-14:**

The guy that invented these is a genius.	1
Best I <sup>2</sup> .	2
A was the most comfortable and the lightest.	6
During wartime there is no time to be messing with buttons.	1
I know goggle A, but thermal as on B would be nice.	1
I have been to combat with goggle A and know its capabilities. Would have to train up on the others.	1
Familiar with.	1
I trust them.	2
Clarity of the image.	3
A lot when wearing at night.	1
Just needs thermal.	3
Weight; too much stuff; heavy.	2
Eyecup was easy to flip.	1

**ENVG:**

Liked the best; had fewer problems.	2
Picture clear (I <sup>2</sup> and thermal brightness could be adjusted separately). If the knobs were changed, the goggle would be great.	1
Good balance.	1
Best because of thermal capability.	1
Best knob design.	1
Better controls.	3
A lot lighter and smaller.	2
A lot when wearing at night.	1
Easiest to use.	3
No so many functions to memorize.	1
Thermals helped greatly.	6
Easier to identify the enemy.	2
More user friendly.	1
Best thermal and I <sup>2</sup> mix.	1
The thermal buttons and ease of use.	1

B goggles are bad.	2
Problems with thermals cutting out.	1
Too heavy.	1
Could have been lighter.	1
Too easy to break while adjusting.	1
Need to find a better way to use batteries.	1
A hassle.	1
Thermal stunk.	1

GENERAL:

I would rather have the weight of goggle A, and the controls of goggle B.	1
Take B's design, then I would take them.	1
Need a goggle with B's controls.	2
I really wouldn't take either of the thermals. They had far too many fatal flaws in each to be trusted.	1
If you combined the adjustment features of B and simple mechanics of A, you'd have a great NVG.	1

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